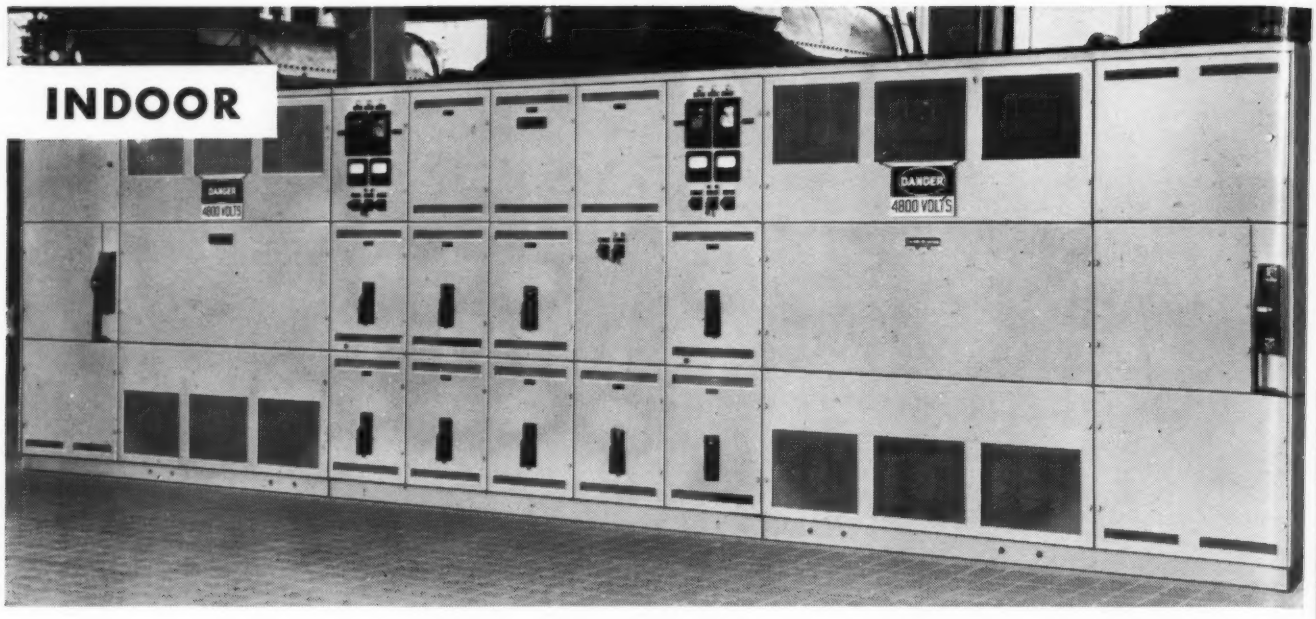
# consulting engineer

August 1955

## Practicing Engineer

SAMUEL A. GREELEY, of Greeley and Hansen, Honorary Member of the American Society of Civil Engineers, the American Public Works Association, and the American Public Health Association, and recipient of the Frank P. Brown Medal of the Franklin Institute of Philadelphia, is proudest of his status as a third-generation Chicagoan.

*—Continued on page 6*

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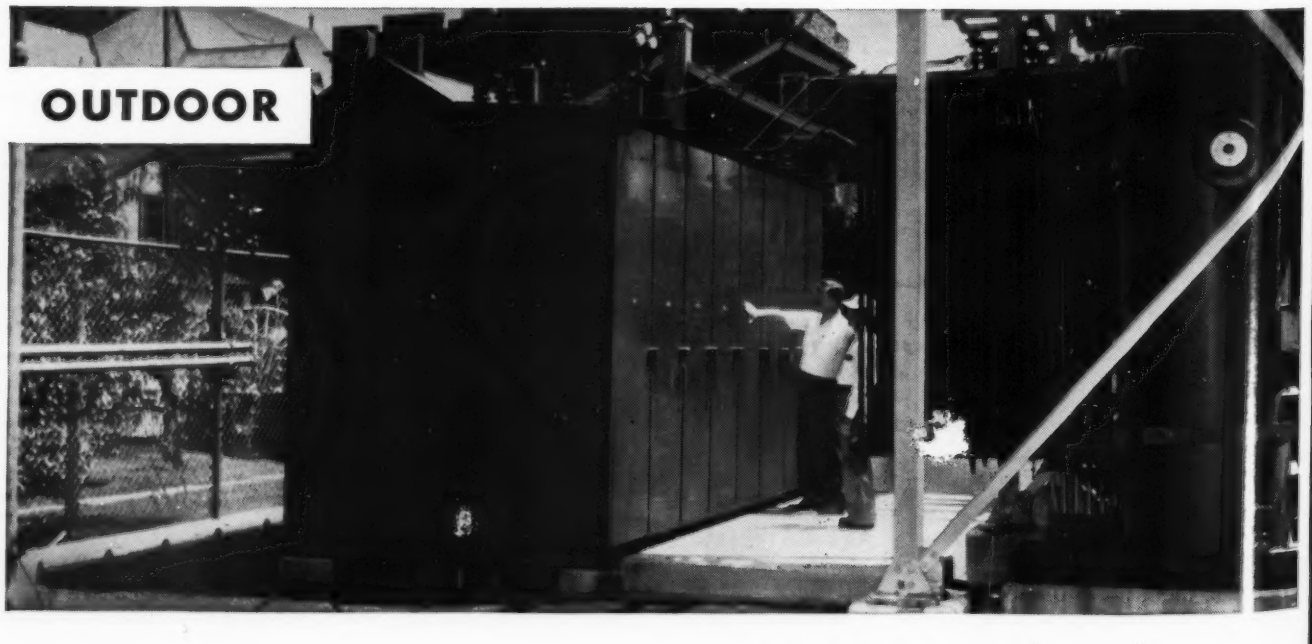

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AUGUST 1955

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## Samuel A. Greeley

*—Starts on front cover*

"My mother's father was Isaac N. Arnold. He came to Chicago in 1838, became a close friend and later a biographer of Lincoln. He served in Congress during the Civil War. My father's father moved to Chicago in 1849, as a surveyor, and my father and I both followed in that we, too, practiced engineering.

"You notice that I said 'practiced' engineering. I think of myself and my firm as 'practicing engineers' rather than 'consulting engineers.' In my opinion, a consulting engineer is a man who offers advice and direction, giving the client the advantage of his knowledge and experience. Ideally, he should not even need an office or a staff—perhaps a stenographer. Practicing engineers, on the other hand, do just what the name implies, they practice engineering. Here at Greeley and Hansen we have a staff of about 80, all but 10 of them engineers. We make reports and designs, draw up plans, write specifications, direct and supervise construction, and occasionally, of course, consult. "Obviously, it is too late for many Consulting Engineers to change their titles to Practicing Engineers.

In my experience, people in general do not understand what an engineer does.

"I am often reminded of the lines from Kipling's poem, 'McAndrew's Hymn,' in *The Seven Seas*—

'They've words for everyone but me—
shake hands wi' half the crew,
Except the dour Scots engineer, the man they never knew.'

"This is understandable. The public has close personal contact with the lawyer, the doctor, the teacher, and the clergyman—just as in Kipling's poem the passengers were in touch with the captain. They never knew that the engineer had anything to do with their safely reaching port.

"Here are two examples of how little the work of an engineer is understood.

"One of my partners once received a letter from an old neighbor and friend, an executive of a large industry. The letter asked my partner if he happened to know anyone with experience in water works, as his company wanted to put in a 30-mile pipe line. He was not being facetious. He simply did not know what kind of work my partner did. Since our organization in 1914, we have had many projects having to do with water pumps and pipes, and yet one of his close friends did not know where to turn for the engineering work on a 30-mile pipeline!

"In another instance, the General Counsel of one of the great industrial corporations, a man I had known for many years, asked his purchasing agent to get in touch with me in connection with some water supply improvements at one of their towns. The purchasing agent dutifully wrote, 'I am told that you furnish water supplies. Please send catalogues, samples, a delivery schedule, price lists, and discounts!' In this case we designed a dam and a complete water works.

"We have much to be grateful for, even if we do not have general public recognition. In no other field do so few do so much for so many. I think this is particularly true in our special field—sanitary engineering. Think of the millions of people served daily by the water, sewage, and waste disposal facilities put in under the direction of just a few engineers. Right at this time, for example, we are designing water works facilities for the District of Columbia, facilities to serve the tens of thousands of people coming into that area. Perhaps a dozen engineers in our office are engaged on that design. Think of the millions of people in New York, Washington, Boston, Winnipeg, Los Angeles, Tampa, and Chicago, (and other cities by whom we and other engineers have been engaged) who, even though they do not realize it, are dependent, to a large extent, for their health and comfort on sanitary engineering works done by a few men here at Greeley and Hansen and in other offices. We have a special satisfaction in our work in South and Central America as, for instance, for Sao Paolo, Barranquilla, and the Republic of Panama. Certainly the young engineer has plenty of chance to do work that will give him the satisfaction he needs.

"I am particularly interested in young engineers and engineering education. There is a lot to this theory of giving a well rounded liberal education to engineers. I believe in it. One day on a train with one of my present partners, I was expounding my ideas on the subject and asking him his opinion. He agreed with me in principle but then proceeded to explain how we had hired him. An engineering graduate with two years of teaching in hydraulics, he walked in one day when I was not in the office and was referred to Mr. Hansen who, it happened, was about to leave on a trip. Our prospective employee was asked two questions as Paul continued to stuff papers into a briefcase: 'Can you run an instrument? Is your lettering good?' When the young man said yes, he was promptly hired. Apparently a well rounded liberal education or lack of it had nothing to do with our hiring a young engineer who later became a partner in the firm. Theory alone doesn't always work out in practice.

"This is an extreme example, but it must be admitted that employers have to be interested in a man's technical ability — a liberal education will not substitute for basic scientific knowledge.

"The solution, I think, is to concentrate on sound scientific learning as opposed to technical training. The engineering schools should concentrate on the

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fundamentals — mathematics, physics, and chemistry, with the other quarter on literature, economics, and history. These are the basic tools of the engineer. All too frequently the specialized courses such as fuels, electrical machinery, power plants, and pipe line hydraulics are pure waste because the student then leaves school and goes into a completely different field. He can learn the details after he finds his kind of work. If he knows the fundamentals he will have no trouble with the specialties. Some years ago I made a survey through my local fraternity at M.I.T. I found that three years after graduation 67 per cent of these engineers were working outside their fields of specialization. In other words, the time they spent in school on such subjects as power plants, ship design, or Sanitary Engineering might better have been given to further study of the fundamentals of mathematics, the pure sciences, and liberal arts.

"Perhaps this might be called the English system. There are no large separate engineering schools in England. Their engineers are trained mostly in the great universities. They study the basic sciences, then they become engineers by achievement rather than by degree or by registration. There is much to be said for that method.

"There is nothing wrong with the ability of the young men today. We have able young engineers here at Greeley and Hansen. They are moving ahead. Just a few years ago, before Mr. Hansen died, we took into the firm as full partners four of the men who had been with us from 15 to 20 years, and were, as an average, 20 years younger than the senior partner. This move, one of our wisest, has made it possible for us to have a partner in direct charge of every project. We do not take more projects than the partners, themselves, can actively head. This limits our business, but that is the way we think an engineering operation should be run. It should never be so big that the partners cannot actively supervise every job.

"We believe in being practicing engineers." ▲▲

## ARTICLE REPRINTS

**A limited number of reprints listed below are available free of charge to our readers. If you need an extra copy please write, using your company letterhead, to: Reader Service Dept., CONSULTING ENGINEER, 227 Wayne St., St. Joseph, Mich.**

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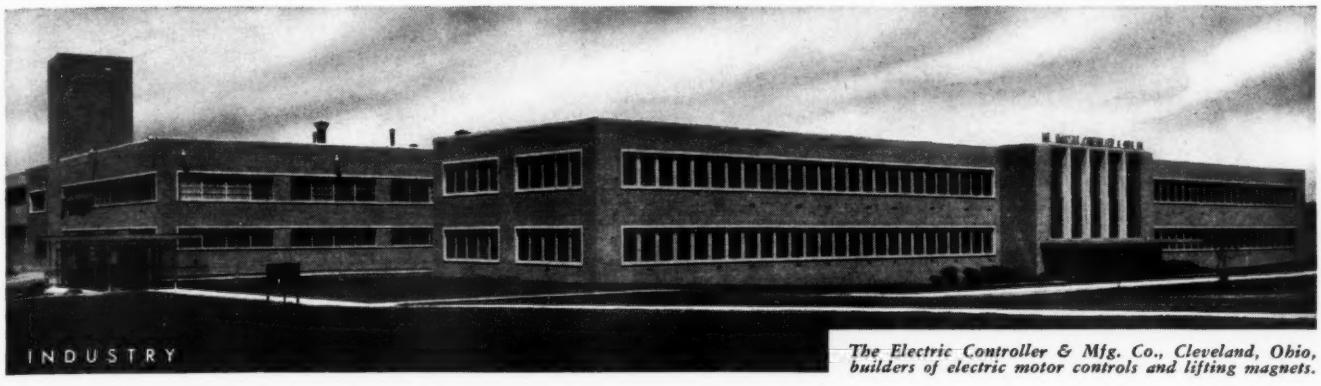


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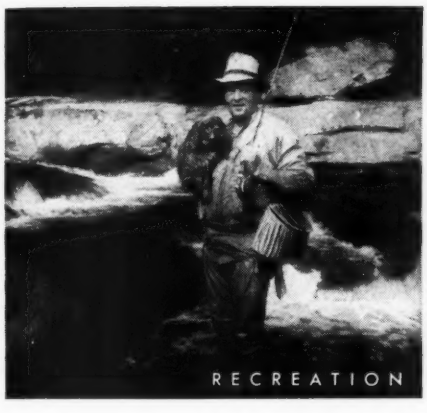

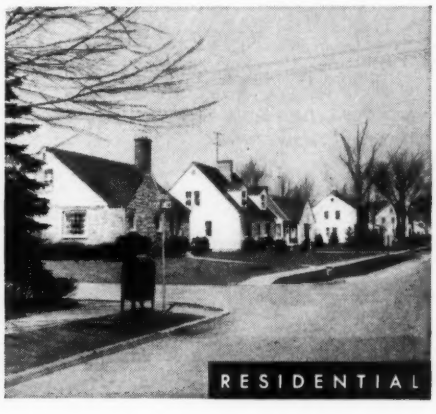


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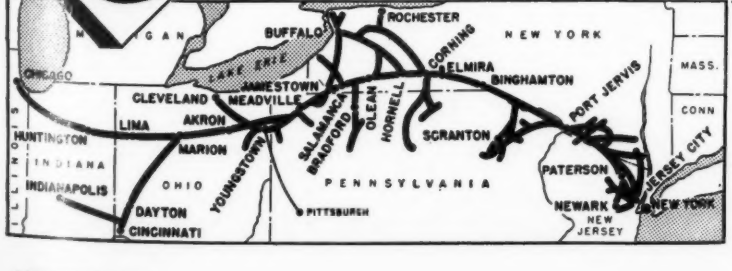


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D. M. LYNN, Assistant Vice President
Industrial Development, Room 524-C, Erie Railroad,
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*Title*_____ *Company*_____

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# READERS' COMMENT

### Alternate Designs

Sirs:

Even if the subject of alternate designs, as outlined by Paul Rogers in the June, 1955 issue, could be considered seriously in connection with architect designed structures, the author should not have indicated that this type of competition is "not only possible, but highly desirable" for power plant construction.

The importance of a tailor-made structural design to accommodate the arrangement, weights and operating conditions of the mechanical and electrical equipment in a power plant cannot be over-emphasized. To achieve an economical, yet safe structure with proper allowance for clearance, vibration, impact and expansion, the structural engineer must work intimately with the equipment data as it develops.

Since power plant structures such as crib houses, coal bunkers, turbine foundations, large stacks, track hoppers, etc., require design criteria not covered in any code or standard specification, the power plant engineers would have to prepare a design specification for the contractor's engineers that was monumental.

The cost of engaging a team of structural designers for each unsuccessful contractor's bid must eventually be charged against overhead on the successful bids, thus passing on additional costs to the owners.

Finally, alternate designs in bidding on any type of project could in time make the structural engineer subservient to the contractor, and instead of gaining prestige, he could end up the employee of the contractor, state registration and all.

M. Zar, Structural Engineer
Sargent & Lundy Engineers
Chicago 3, Illinois

• MR. ZAR'S LETTER WAS REFERRED TO THE AUTHOR WHO REPLIED AS FOLLOWS:

Sir:

Referring to my paper on "Alternate Designs," June, 1955, issue, Mr. Max Zar believes that the system of alternate designs would not be feasible for power plant construction. The writer begs to differ with his point of view. Special structures such as crib houses, coal bunkers, turbine foundations, large stacks, track hoppers, etc., are precisely in the category where an independent consultant might bring about improved designs and economies.

In the case of coal bunkers, for instance, economies in five or six figures may be obtained for large units, compared to use of out-dated designs.

Several parts of power plants are already subject to alternate designs, e.g., cooling towers, precipitators, material handling systems, etc., all of which are furnished as a packaged deal, including design.

Excepting routine floor framing around mechanical equipment, practically all major framing of power stations can be, in the opinion of the writer, subject to alternate design. An independent consultant who is not obstructed by squad bosses, chief draftsmen, project engineers, etc., can put forth new ideas and present them to the top management for approval.

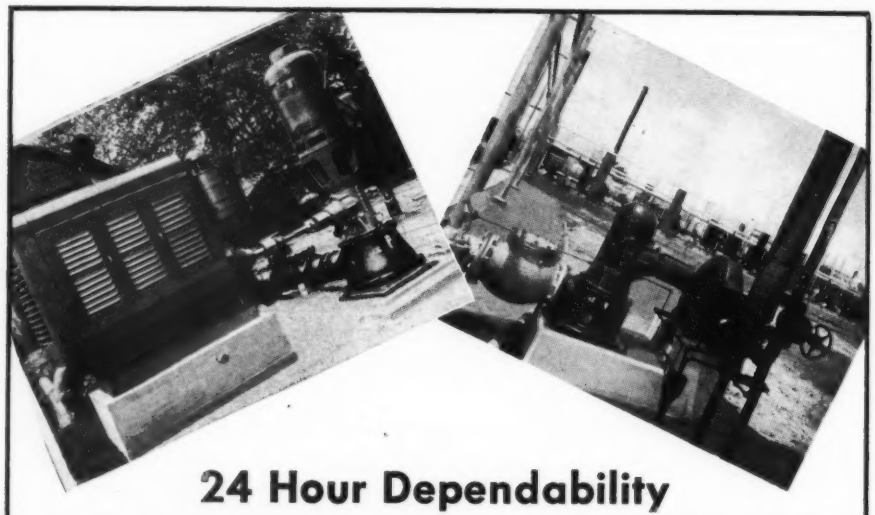
Paul Rogers
Paul Rogers & Associates
Consulting Engineers
Chicago 10, Illinois

Sir:

I read the article "How About Alternate Designs?" with great interest (June '55).

The American Institute of Architects is opposed to alternate design. Our policy is as follows:

"The American Institute of Archi-

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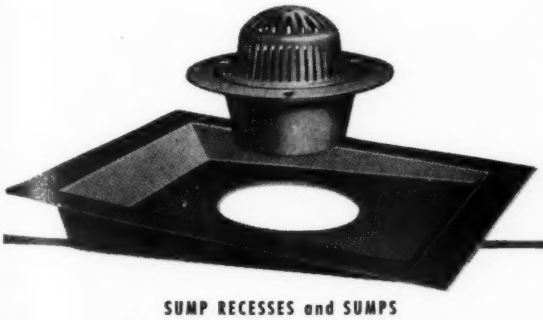

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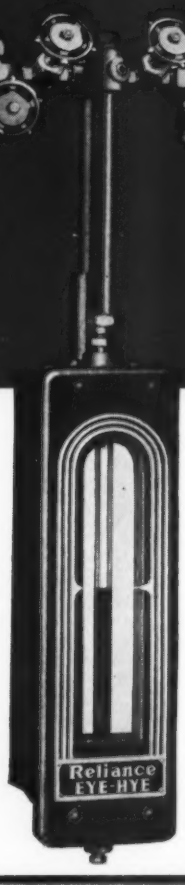


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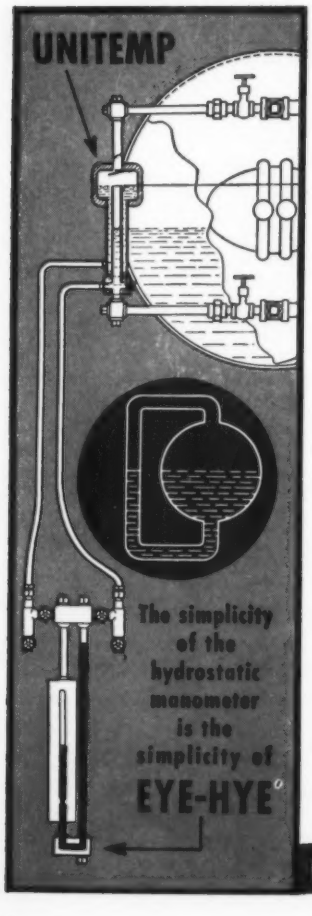


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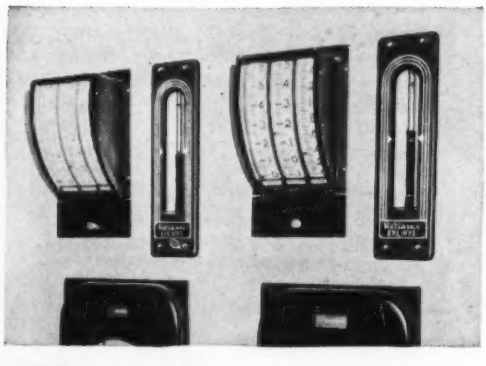

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tects is opposed to the requesting of bids on alternate designs unless the alternate designs have been prepared by the architect in the bidding documents."

We are firmly opposed to the submission of alternate designs by a bidder on alternate designs prepared by himself.

Edmund R. Purves,
Executive Director
The American Institute
of Architects
Washington 6, D. C.

### Naef of Mississippi

Sir:

Having obtained such a great kick out of seeing on the front of your June 1955 publication a photograph of a man having a name very similar to mine, and wanting to pass this along to other members of my immediate family, I am wondering if it will be at all possible to obtain 10 or 15 copies of the front page, as well as the article on page 6 giving the story on the achievements of Robert A. Naef of Zurich, Switzerland, President of the International Federation of Consulting Engineers.

Robert W. Naef
Architect-Engineer
Jackson, Mississippi

### Air Pollution

Sir:

I have read with much interest the article on air pollution by William G. Christy which appeared in CONSULTING ENGINEER for April, 1955.

There are two questions which came to my mind as I read the article, and I wonder if you could propound them to the author.

First, I am curious as to the application of multiple tube high efficiency cyclone collectors or electrostatic precipitators on oil fired burners. Do conditions arise where such an arrangement is of advantage?

Second, I should like to inquire as to what determines degree of control for coal fired units. What conditions suggest use of either a multiple tube collector or an electrostatic precipitator or a combination.

Your assistance is appreciated. I might add that you are to be complimented on your magazine which has been most interesting from the very first issue.

V. C. Behn, Engineer
Atlas Powder Company
Wilmington 99, Del.

• QUESTIONS WERE REFERRED TO MR. CHRISTY.

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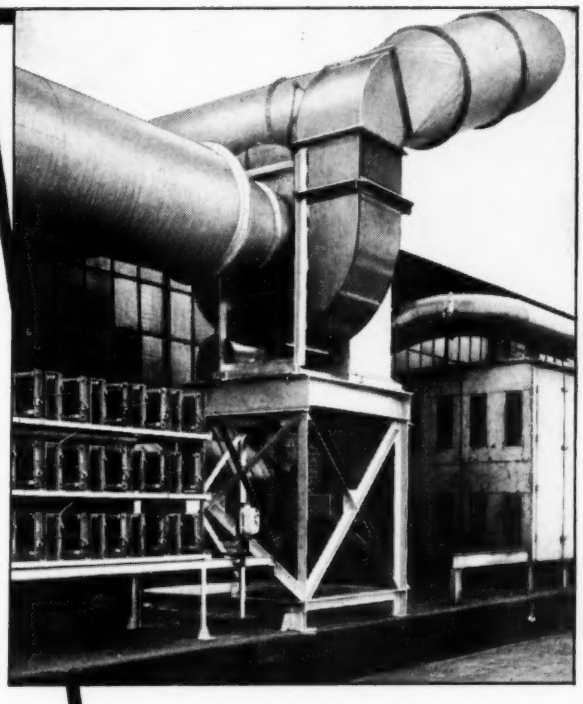

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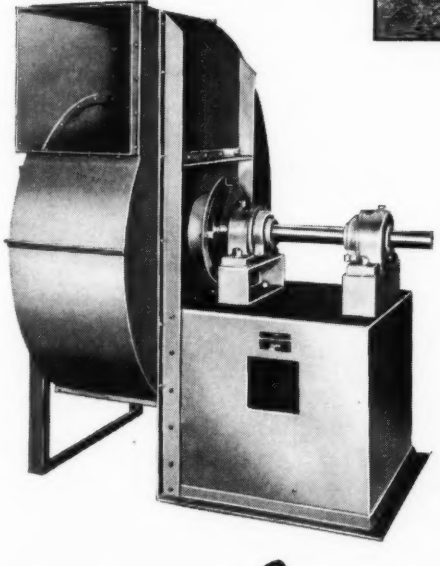

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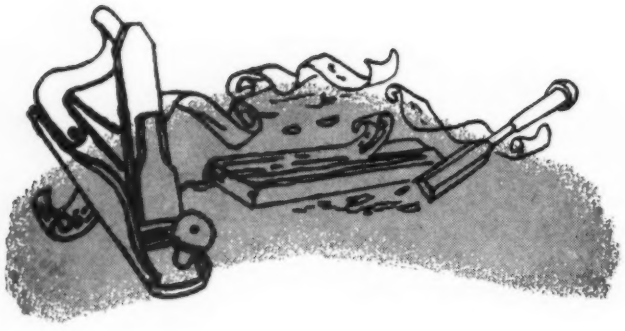


# SCRAPS & SHAVINGS

IF A PATENT MEDICINE manufacturer were to offer free physical examinations, diagnosis, and treatment along with every purchase of his product, the American Medical Association and the public would be extremely leery of both the product and the medical services offered as a bonus. Yet some manufacturers of industrial equipment and some public utilities and associations do not hesitate to offer free engineering along with their sales.

Every manufacturer has a legitimate interest in the correct application of his equipment. The manufacturers of boiler feed pumps, for example, have every reason to want their pumps properly specified for the job, properly installed, and correctly operated. This is a job for their applications engineers, and these men are of great service to consultants and plant engineers alike in making sure that the characteristics and qualities of their products are understood by the consultant and his client. This is part of the pump manufacturer's sales program. But if a pump manufacturer were to say to a prospect, "If you will buy my feed pumps, I will handle all the engineering on your new steam plant," that would be quite a different matter. This would be as far fetched as the patent medicine manufacturer offering a physical examination with every 49c bottle of tonic, but there are actual instances — all too numerous — in which manufacturers are advertising offers that are almost as extreme as that.

Perhaps the worst offenders are in the electrical field. Public utilities toss the word "engineer" around as though it were a title applicable to anyone who can read a light meter or pull a wire. Most utilities will handle the "engineering" of a new lighting installation free. The National Electrical Contractors Association even went so far as to spend something over $9,000 to carry a page advertisement in *Time* to tell how their members (electrical contractors) can handle electrical engineering work without charge. The ad implies that a member of the National Electrical Contractors Association is automatically qualified to analyze, recommend, specify, and install electrical equipment. While we do not question the ability of these contractors to install, we do question not only their ability to analyze, recommend, and specify but their legal right to enter into these fields. Belonging to the National Electrical Contractors Association in no way implies engineering registration by a state.

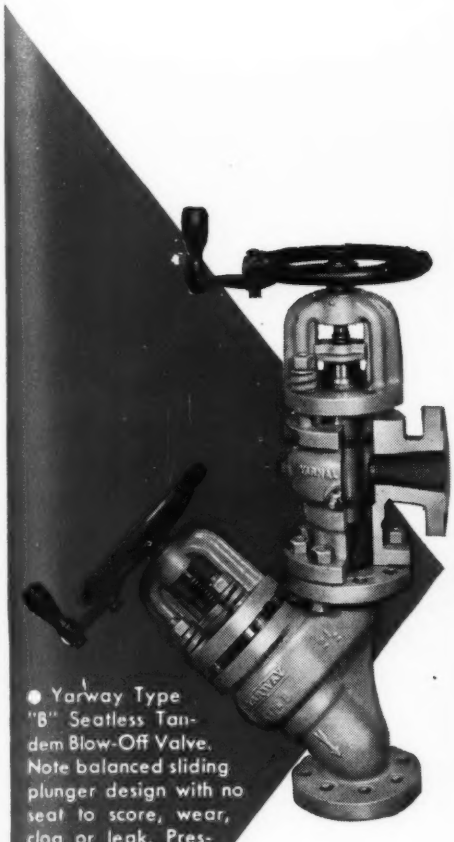
While state laws vary, the majority of states require the seal of a registered engineer on all engineering work "which affects the safety of life, health or property, or the public welfare."

If manufacturers, utilities, or associations are willing to hire registered engineers who will sign drawings and specifications and thereby make themselves and their employers liable for their engineering work, there can be no legal objection to this practice. But few of these employee or contractor "engineers" are registered professional engineers. Even those who are registered would be unwilling personally, or their companies would be unwilling for them, to assume the responsibility of signing and sealing recommendations or specifications.

Therefore, the answer is for the consulting engineers to see to it that the state registration laws are enforced and that plans and specifications are sealed by registered engineers in every state in which the seal is required by law. According to the "Synopsis of State Engineering Registration Laws," published by NCSBEE, this means all of the states except Alabama, Massachusetts, Missouri, Nebraska, Tennessee, Virginia, and Wyoming. (California requires a seal only on C. E. plans, while Delaware requires the seal only on public works.)

We doubt that many manufacturers, utilities, or associations know that they are advertising their willingness to break the law. Most do not even know that engineering registration laws exist or that these laws require the seal of a registered engineer on all engineering work. Also, few court cases have come up, and court decisions are needed before we can know what the legal definition of engineering work is and what is simply sales application work.

This is one of the real problems facing consultants, and it should be on the agenda of the coming meeting of the Associations of Consulting Engineers, on October 28, in St. Louis. Representatives of seven independent state or regional Associations of Consulting Engineers plan to attend this meeting with the idea of forming some sort of Federation of their groups. Certainly some time should be given to a discussion of this problem of "free engineering." Perhaps we can make a start toward a solution at St. Louis. All interested groups of consulting engineers are invited.



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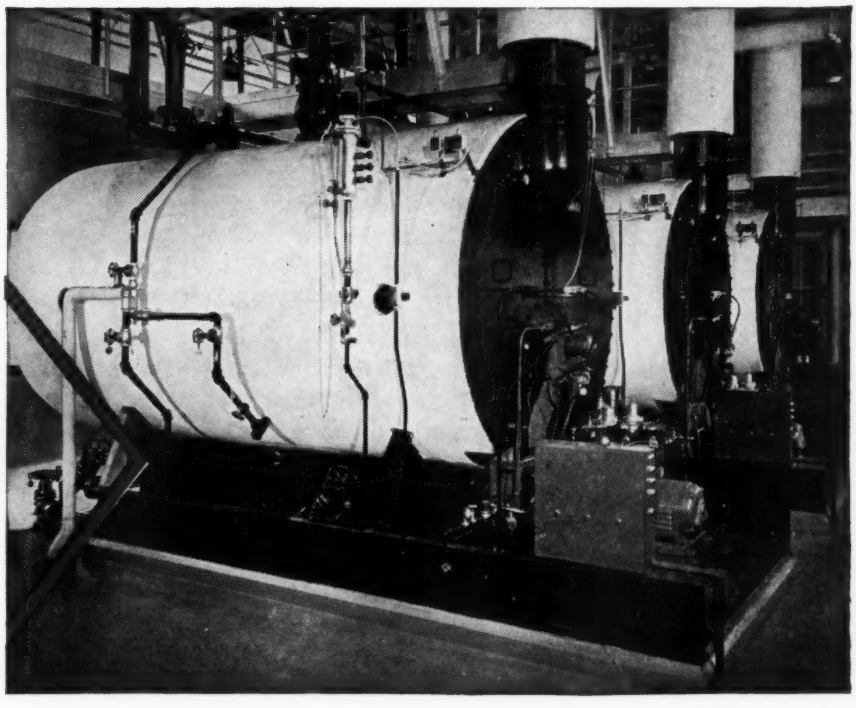

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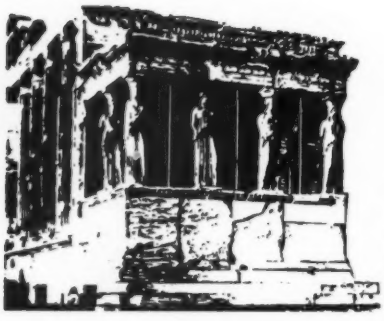

# REPORT FROM ATHENS

**FRITZ D. HIRSCHFELD**
**European Editor**

SINCE THE Greeks, with our material and financial assistance, threw the fighting communists out of the country about five years ago, they have made rapid progress in getting back on their economic feet. And while not everyone has shoes or is eating three meals a day, there is no longer the devastation that existed after almost a decade of German occupation and communist civil war.

If you could judge the rest of Greece by Athens, you would say that things were booming. Almost everywhere you look new buildings are going up. And outside of Washington, D.C., I have never seen so much marble used in construction — everything from curbstones to stadium seats.

Since inflation has been largely licked, some of the hoarded gold has come out of hiding, and this has created more confidence in long-term investments. The government, too, has proven cooperative. Government operations have been streamlined, dollar reserves built up, the trade gap greatly reduced, and foreign investment laws passed which seem to be fair and favorable to the investor.

American consulting engineers have been active in Greece since the earliest days of American intervention. At that time it was recognized that one of the biggest obstacles to industrialization was the lack of power. Ebasco Services, Inc. was chosen by the Greek government to survey the potential power resources and requirements as a first step towards giving the country a firm industrial base.

Taking advantage of the existence of extensive deposits of low-grade lignite as well as potential sites for hydro-electric power development, the recommendations of the Ebasco study were fulfilled by the construction of three hydro-electric and one thermal station, totaling 175,000 kw. Completion of this system in the fall will more than double the previous power supply in Greece. And through an 800 mile, looped (150,000 kw) distribution network, this cheap and reliable power will be made available on a nation-wide basis. Plans are also going ahead to add an additional hydro and another steam station in the very near future.

Burns and Roe, who were selected as the prime contractor for the design and as construction supervisors of the 80,000 kw steam station (Aliveri power plant) which went on the line in 1953, are presently closing out their work in Greece. The Public Power Corporation, set up by Ebasco to operate the entire power system, has been gradually turned over to Greek personnel until now it is Greek-run.

Our American aid (over $2 billion) has helped the Greeks revitalize and expand their agriculture, construction, shipping, and other industrial and commercial enterprises. Of more dynamic interest are the Greek people who are responsible for these achievements and who hold the key to the future of their country.

Like many stories, this one has its "big" people — those who travel about in Mercedes cars — and its "little" people who can be seen riding to work on their mules or bicycles. Both can claim some credit for the remarkable recovery and growth.

The reports of the Burns and Roe engineers who were responsible for supervising the construction of the Aliveri power plant give first hand insight into American experiences in working with the Greek people. Here are some excerpts from Burns and Roe engineering reports.

"The inexperience of labor on this project, a situation which can be found in most underdeveloped countries, is worthy of mention . . . .

"The larger percentage of workers used, mostly unskilled, came from little villages and farms . . . . The Greek worker was generally willing and fearless, showing little concern over the hazards inherent to a large construction project of this kind. His efficiency was commensurate with his background on the small farm or his intermittent experience gained on the type of construction work peculiar to a small village where primitive conditions are still in existence. He was generally a happy individual who always returned a smile. Beneath this surface, however, he appeared to be inwardly quite serious and ever mindful that his country was once occupied, on one occasion for some 350 years (ending in 1821), and has since been engaged in many wars.

"With this background, the Greek worker is very democratic minded, is fully conscious of his rights, and actively supports his labor union. Legal representation is freely used and unwitting violation of

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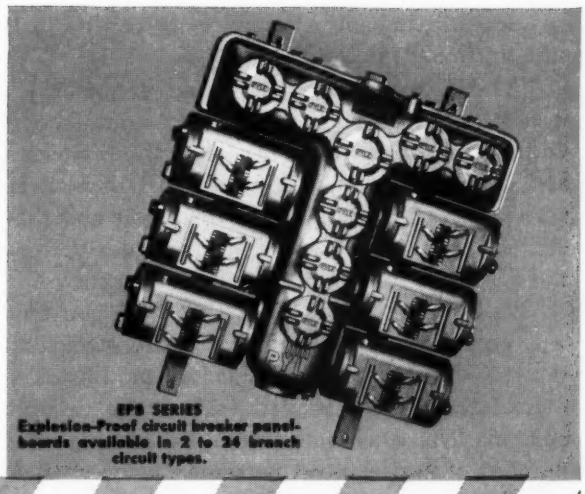

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any legal technicality immediately results in a lawsuit with the employer.

"[The foreign supervisors and engineers] found that it was necessary to learn to know the people with whom they were working, their background, and capabilities. They also learned that their own activities were being closely observed and that success would be realized only after they had gained the respect and confidence of the worker. . .

"The successful bidder [for the stack construction] was an Athens firm founded by the grandfather of the present owners, who inherited the business from their father. They proved to be very reliable and efficient. The work was accomplished by a minimum number of experienced workmen in good time with a minimum amount of equipment. The workmanlike manner in which this job was accomplished, with little or no requests for assistance, was not only a credit to the firm but an inspiration to all others on the project who were fortunate enough to observe the operation."

While these quotes from the report are no more than casual observations, one can sometimes learn a great deal more about the characteristics and abilities of the people in a foreign country by reading a few construction reports that have no axe to grind or classical theories to uphold, than by reading the more common literature.

There is other evidence that the Greeks, given the proper training, tools, and leadership, will work hard and efficiently to produce results. Tippetts-Abbott-McCarthy & Stratton, for example, maintain the major part of their design and engineering staff in Athens — although most of their work is in other Middle East countries. This is primarily because of the good quality of personnel available. For generally the same reasons, the Eastern District of the Joint Construction Agency makes Athens their headquarters for the military construction program in the Middle East.

### The Greek Leaders

Turning to the leaders who are responsible for guiding the industrial developments in post-war Greece, one finds many high caliber men. I was invited by one of the leading Greek textile industrialists, Mr. Christopher Catsambas, to visit his new spinning plant located directly on the Bay of Eleusis, about an hour's drive from Athens. The plant, as might be expected, is quite a showplace, especially for Greece.

As we rode through the countryside, Catsambas told me in broad general terms how he felt that the future of Greece was closely linked to the U.S. Last year, it seems, he wanted to build a new plant but needed capital to buy machinery. Completely on his own, with his balance sheets and proposed plans under his arm, he went to the U.S. and to the Export-Import Bank. He explained his needs. He wanted to borrow approximately $800,000 to purchase machinery, but he could offer no guarantees for repayment other than his own good name and the present credit standing of his business. The man got his loan.

I asked him why he did not go to England or Germany or Italy to purchase machinery. He had established credits there and would have had no difficulty in obtaining the needed capital.

### Greek Future Tied to U.S.

Catsambas had an answer. "Sure, I could have gotten the credits in Europe and probably even purchased the machinery a little cheaper than in the United States. But I'd rather do business with the States even if it does cost me a few dollars more. After all, it's American capital that has put Europe on its feet, and if European firms can afford to finance my purchases it's only because they in turn have been indirectly subsidized by the U.S.!

"I want Americans to take an interest in Greece, and the only way I know of doing it is to get American manufacturers interested in doing business with us. Now, the way I see it, if I buy my textile machinery from an American company, then that American manufacturer is going to take a direct interest in my operations. They'll send their installation engineers and, who knows, they might even have their sales representatives put Athens on their itineraries. Then when they see that I meet my obligations, and as my firm continues to expand, I'll have friends in the U.S. to turn to who can assist me further. We Greek businessmen believe that much of our future is tied to that of the U.S., and the way to make American businessmen take notice of us is to do business with them as much as we can. It's as simple as that!"

These ideas carry weight, since Mr. Catsambas is not only one of the leading businessmen in his country but also President of the Greek Federation of Industries, a position in which he often acts as spokesman for his colleagues. As an interesting sidelight, the younger generation of the family, now entering into the business, has been or is being educated in the States.

### Vitality — Hope for the Future

The Greeks, both "big" and "little", are enterprising. Back a few thousand years ago the same enterprise helped them dominate the trade and commerce in the then known centers of civilization. Now, as twentieth century technology is causing the Middle East to re-emerge in a boom of oil and industrialization, it is not unlikely that Greece may again play an important role — not only as a center of trade but now also as an industrial hub. The old ruins on the Acropolis represent the glory of a past age, the living vitality of the Greek people represents the real hope for the future. ▲▲

# the Legal Aspect

MELVIN NORD
Consultant in Legal and Technical Problems
Registered Professional Engineer
Patent Attorney

## *Labor Law: Types of Economic Pressure Exerted by Unions (III)*

IN THE PREVIOUS column in this series, we considered some forms of economic pressure exerted by unions, i.e. strikes for higher wages or improved working conditions, strikes against technological change, jurisdictional strikes, sympathetic strikes, and the general strike. We shall now consider other forms of economic pressure used by unions.

### Strikes for the Closed Shop

A major objective of unions is the "closed shop." This is an agreement by the employer not to employ non-union workers. A somewhat similar agreement is the "union shop," in which the employer requires any employee he hires to join the union within a specified time in order to continue as an employee.

The courts of the various jurisdictions have not been able to agree as to whether or not strikes to attain a closed shop or a union shop are legal. The reason for this is that the result obtained depends upon the view of the analogy between ordinary competition on the one hand, and of labor-management competition on the other.

One view is that a strike for the closed shop does not involve competition between the employer and employees, but between two groups of employees. In this view such strikes are illegal, and they have been so held by courts a number of times.

The other view is that such a strike is for the direct economic benefit of the organized employees, since it greatly strengthens the power of the union in its subsequent struggles with the employer. The only trouble with this sort of a justification for the *prima facie* tort of intentionally injuring someone, is that it is not sufficient justification, at least as an abstract proposition. As pointed out in the previous column, the mere fact that a certain activity will help the union is not sufficient to justify the action, any more than it would justify putting one's hand in another's pocket in order to "help one's self."

Nevertheless, more courts have held strikes for the closed shop legal than illegal. The reason for this is that the issue is not really a question of logic, but of policy. It is not, in other words, a question of what the rule is, but what it should be. As a matter of fact, it is not possible to say just what the rule is as a pure matter of precedent or of logic, because the rule can only be determined by extrapolating from an analogous field, and there is nothing particularly logical about extrapolation. Whenever the extrapolation is too great, its validity becomes uncertain. That is the case here, and as a result, the decision of a number of courts has really been on the basis of what they thought the law should be as a matter of policy, rather than what they thought it was as a matter of precedent or logic.

Whenever this is the case, it is best to settle the problem by legislation, rather than by continuing to dump problems of policy in the laps of judges who were not selected for that purpose. Legislation has been passed in a number of states, and also in the Taft-Hartley Act making a strike for the closed shop unlawful. Where any of these statutes is in effect, that settles the problem—at least for the time being.

### Secondary Strikes

Finally, there is the problem of a strike in which one union applies economic pressure against two employers, with one of whom there is a dispute. The object of the strike is to force the "hostage" employer to force the other employer to do what the union wants. This roundhouse type of blow is a secondary strike, or secondary labor boycott. It has generally been held to be illegal, on the ground that it does not involve competition between the union and the employer with whom there is no labor dispute.

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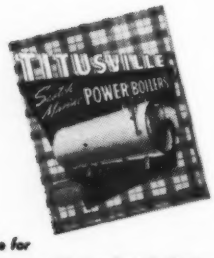


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with the terms the seller proposes, he can of course refuse to buy. If he organizes with other consumers who are dissatisfied with the terms offered by the seller this is a primary consumption boycott. As pointed out earlier, this is legal.

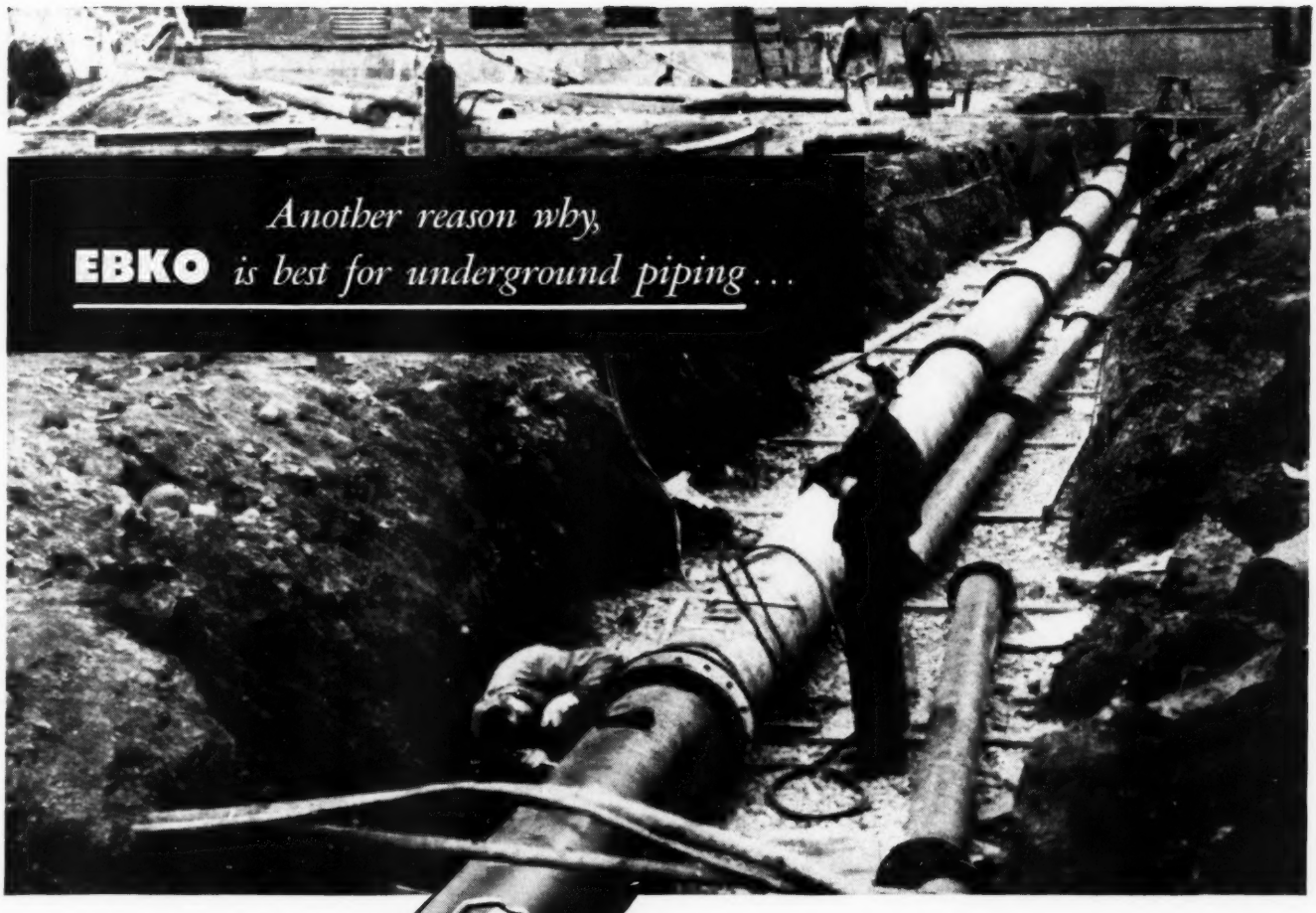
However, if a person is dissatisfied with the terms of the seller of goods he is not privileged to organize his friends, who have no dispute with the seller, to refuse systematically to purchase from the seller or from his customers. This type of "ganging up" is unfair competition. It is a secondary consumption boycott, and as such has always been held to be illegal.

The doctrine is most frequently applied, however, to labor unions. If a labor union gets involved in a labor dispute with an employer, it is not permitted to organize a consumer's boycott among all the laboring people in the locality.

The fact that this is a very powerful weapon of labor, or that in some cases it may be the only effective weapon available to the union, does not make it lawful, nor does the fact that each consumer individually has the right to refuse to purchase from anyone. This is no more justifiable than the action of one performer organizing a "reverse-type claque" to hiss another actor's performance. To be sure, anyone has the right to hiss, but it doesn't follow that you can gang up on your competitor by hiring a bunch of organized hissers.

### Picketing

There are two ways of looking at picketing, and the courts have looked at it both ways (sometimes simultaneously). Either picketing is unjustified because it is a form of inducing "neutral" consumers not to buy, i.e. it is a secondary consumption boycott, or else it is simply the exercise of free speech, and therefore guaranteed as one of the civil rights by the Federal Constitution. Not only has each of these views been held by various courts



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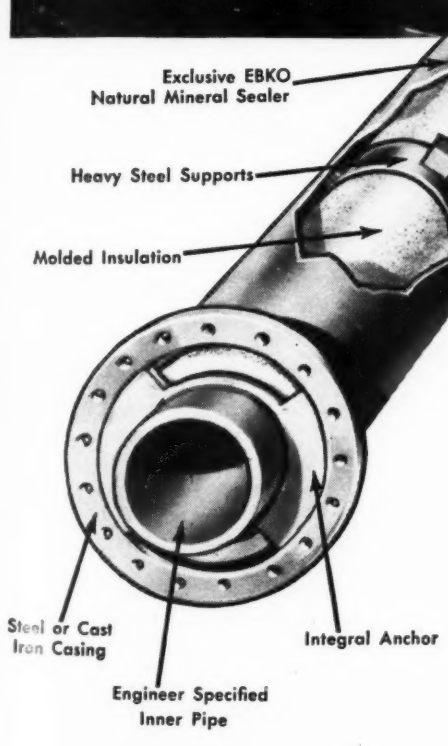


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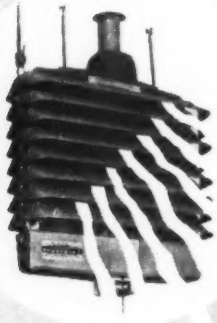

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at various times, but so have all the in-between views.

Before 1940, the courts had, by a number of intuitive steps, hacked out a theory that peaceful picketing by employees for justifiable ends was legal, but that "stranger picketing" (i.e. by non-employees) was illegal even if it was peaceful. It would be futile to try to explain just what logical justification there is for this position, since there doesn't seem to be any. If logic could answer this problem the answer would be that picketing is illegal, since it is nothing but a secondary consumption boycott accompanied by sentries carrying signs. However, logic is not a particularly powerful tool when it is pitted against strong (not to say violent) emotions. Arrayed on the other side of the argument is the plain fact that it is asking too much of human nature to expect a striker, who may be living on his last dollar, to be silent when he sees the employer merrily going on his way making money regardless of the strike. "At that rate," thinks the striker, "the employer can last forever—which is a lot longer than I can." So, being a man rather than a "logical" piece of machinery, he begins to "announce" to others that there are some pretty excellent reasons why they shouldn't patronize that store (i.e. "They sell scab beer"). "After all," says the proponent of picketing, "although silence may be golden, free speech is worth fighting for." And with them fightin' words, he is ready for a fight.

If one can get around to viewing the question of picketing in a vacuum, (i.e. without the fighting words), it seems clear that he must conclude that picketing is an organized attempt to produce a secondary consumption boycott, and is by far the most successful type of secondary boycott so far invented. Even disregarding the possibility of violence, picketing is still—as a matter of cold logic—a secondary consumption boycott. And looking at it realistically, one can hardly deny that a line of a hundred or more rapidly moving, gesticulating, determined people can be just a little more convincing to prospective customers than an advertisement in the newspaper.

As a result of diverse pressures and views of policies, the courts by 1940 had arrived at the position stated above simply as a matter of compromise, i.e. in a semi-legislative fashion. But in 1940, the roof caved in. Following the passage by a few state legislatures of statutes prohibiting picketing under certain circumstances, in 1940 the United States Supreme Court handed down an astonishing decision in which they held that these statutes were unconstitutional because picketing is nothing but the exercise of free speech. Even the Supreme Court was confused by this and has been reversing its field ever since. Several anti-picketing statutes have managed to avoid being declared unconstitutional somehow or other, in one case by the simple expedient of inserting a clause in the statute saying that "nothing contained herein should be interpreted as abridging the right of free speech!"

Although this makes the law of picketing something less than clear, it appears from the latest cases that peaceful picketing is illegal if it has as its object something that is unlawful. In other words, if a strike for the given objective would not be lawful, neither will picketing. Otherwise, picketing is legal.

The result of all this should be to teach us the lesson that labor law is not really a matter of logic or precedent so much as it is a matter of policy. It is up to the legislatures to state what policy the public desires in matters of this sort.

In the next column, we shall consider the effect of legislation on labor law. ▲▲

# FENESTRA Steel Roof Deck Speeds Erection...Cuts Building Costs

Warehouse and factory buildings cost less and are completed faster when designed for Fenestra* Steel Roof Deck construction. Combining lightweight with great strength, these roof decks reduce the cost of foundations and structural steel framework compared with heavy slab construction.

A single sheet of Fenestra Steel Roof Deck covers 30-40 sq. ft., and a small crew can erect over 10,000 sq. ft. every day. As soon as deck is laid and interlocked the roof is ready for insulation and roofing without delays for curing and drying.

Fenestra's specially designed insulation clips can eliminate combustible adhesives between the insulation and roof deck.

Before you plan your next building get complete details on Fenestra Steel Roof Deck. Call your Fenestra representative or write Detroit Steel Products Company, Dept. CE-8, 3443 Griffin St., Detroit 11, Michigan.

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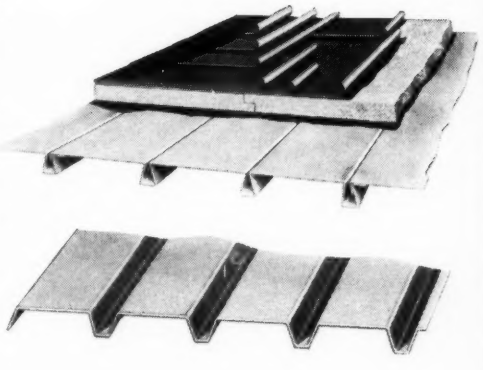
### HOLORIB and ECONORIB

Strong lightweight steel roof deck construction, *plus* a noncombustible finished ceiling... all in *one* structural unit.

HOLORIB'S unique pyramidal-shaped ribs combine greater strength with increased bonding area. Specially designed nonpiercing insulation clips can be used to eliminate combustible adhesives between roof deck and insulation.

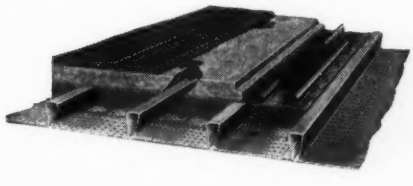
ECONORIB'S "V"-shaped rib design, with maximum ¾" rib opening, provides standard steel roof deck construction with economy. Full 24" coverage for fast erection.



### ACOUSTICAL HOLORIB

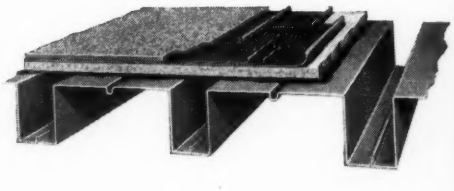
A combination acoustical-structural roof that costs as little as 75¢ per sq. ft.—*installed*. You get perforated 18-gauge Holorib Steel Roof Deck that forms a good-looking, easy-to-maintain interior ceiling, plus a noncombustible acoustical element *built right in.*

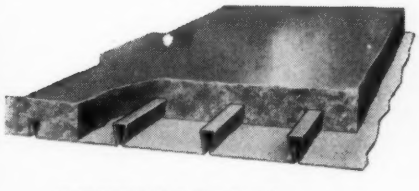
Designed into your factory building, Acoustical Holorib assures efficient noise control and eliminates expensive additions for acoustical treatment.



### "E" ROOF DECK

Fenestra's NEW Type "E" Roof Deck is designed for low-cost construction on spans up to 20 feet. It eliminates short span joists and intermediate purlins. A longitudinal stiffening rib gives increased strength. The galvanized surface provides a noncombustible, beam-type interior ceiling.





### HOLORIB Reinforcing Forms for concrete floors and roofs

An economical structural unit combining forms and reinforcing steel for concrete slab construction carrying live loads up to 200 pounds per sq. ft. Fast erection over the entire floor area speeds building completion.

Roof deck construction using Holorib Reinforcing Forms with lightweight insulating concrete has a 1-hour fire-resistive rating.

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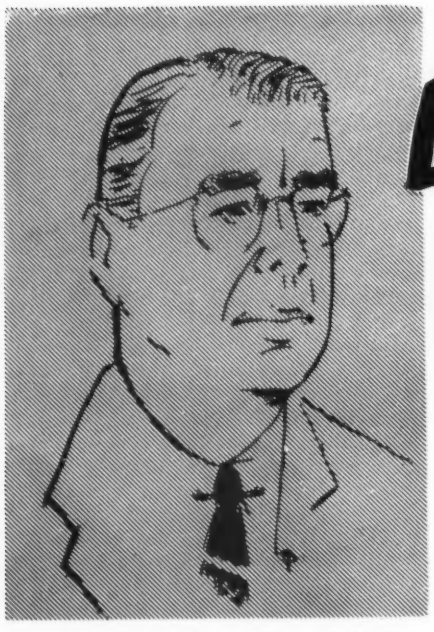


# Economic News Notes

*E. J. Mac Donald*
*INDUSTRIAL ECONOMIST*

CRITICIZES TREND — Prof. W. S. Evans, Univ. of Maine, told the ASCE convention, "There appears to be a widening gap between what the engineering schools turn out and what employers of civil engineers expect. The current trend toward making engineering curricula more general and more scientific has resulted in less drawing, less surveying, less design, and, in fact, less of everything the young graduate would normally find useful immediately following graduation."

BLAME CONGRESS — Few government-compiled statistical series are as criticized as are construction data. The Department of Commerce is aware of its shortcomings, estimating that certain published figures might run as much as 10% in error, and requested $1.3 million for improving the reliability of construction data. The House refused to go along with a Senate approval for even half the amount. Result: no appropriation and no improved construction figures except as sweated out of current means.

JUST IN CASE — Construction of an underground power control center has been started by Consumers Power Co. at Jackson, Mich. It is designed to be bombproof and "strong enough to support the main office building if it were to fall on it." Going beyond anything done to date in this respect by other utilities, the Michigan firm will provide an underground area of 4,250 sq ft built of reinforced concrete and roofed with steel beams encased in concrete. The control center will have a self-contained air supply, provision for emergency power, communications, and lighting, and emergency canteen facilities to make it self-operating if necessary.

BROOKLYN DEAL — One of the more interesting "big-city" real estate transactions of the year to date was the acquisition by the Port of New York Authority from the N. Y. Dry Dock Co. of a couple of miles of Brooklyn waterfront complete with piers, sheds, and 50 acres of upland area and warehouse space for $13,750,000. The Authority has announced that purchase of this property constitutes the initial step in an $85 million marine terminal re-development program.

DISTAFF SIDE — The Department of Labor has published a booklet, "Employment Opportunities for Women in Professional Engineering." In stating that women comprised as little as 0.15% of the total number of engineering grads in a recent year, the study points up the extent of this potential source of engineering "man"-power.

NEW INSTITUTE — The $8.5 million Glenn L. Martin Institute of Technology has been dedicated at the University of Maryland. The College of Engineering and research departments of the College of Arts and Sciences are quartered in the eight-building addition at College Park.

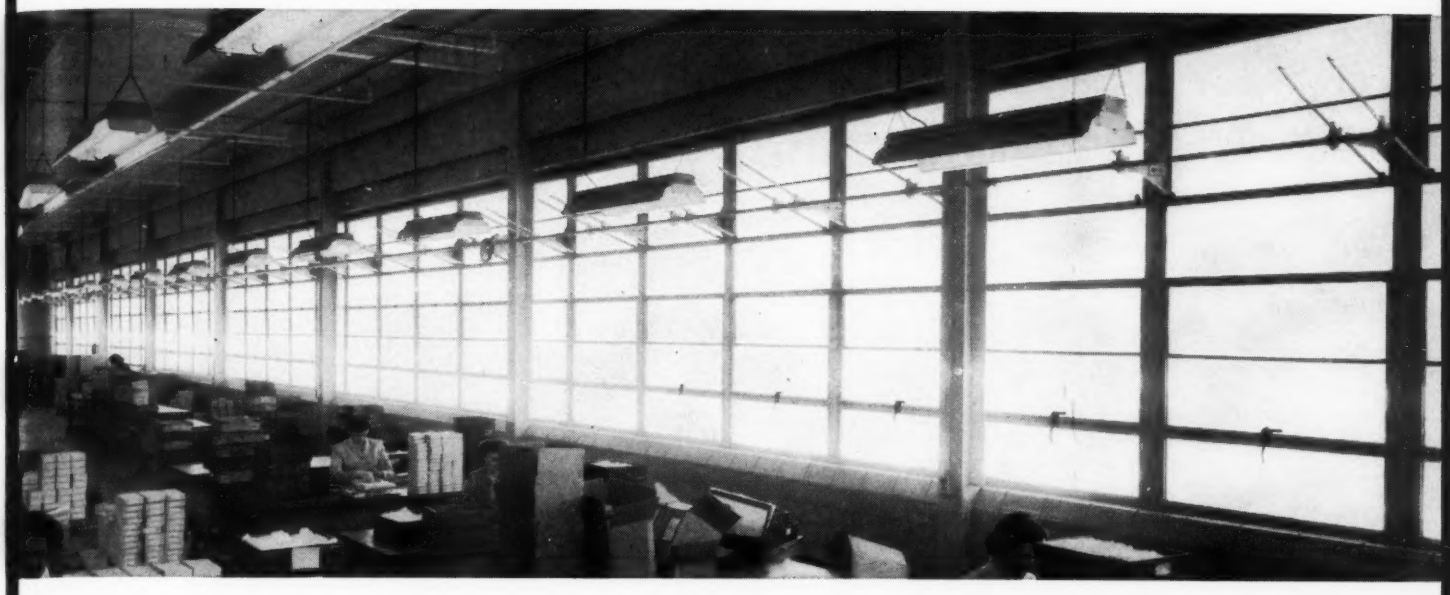
DIXIE DIVERSIFIES — The sharp expansion in recent years in North Carolina of electrical and electronic industries is spilling over into South Carolina. General Electric is constructing a $6-7 million plant near Columbia for the production of radio and TV capacitors. Industrial plants located in "rurban" areas of the South have paced the new trend in factory design and layout and in industrial decentralization.

INDUSTRIAL DISTRICT — The Flowood Industrial District at Jackson, Miss., is the latest addition to the growing number of planned industrial districts in the nation. Consisting of 300 acres in a rural county within the Jackson Metropolitan Area, the district is served by two railroads, U.S. highways, and with natural gas as well as electric power. Brochure available.

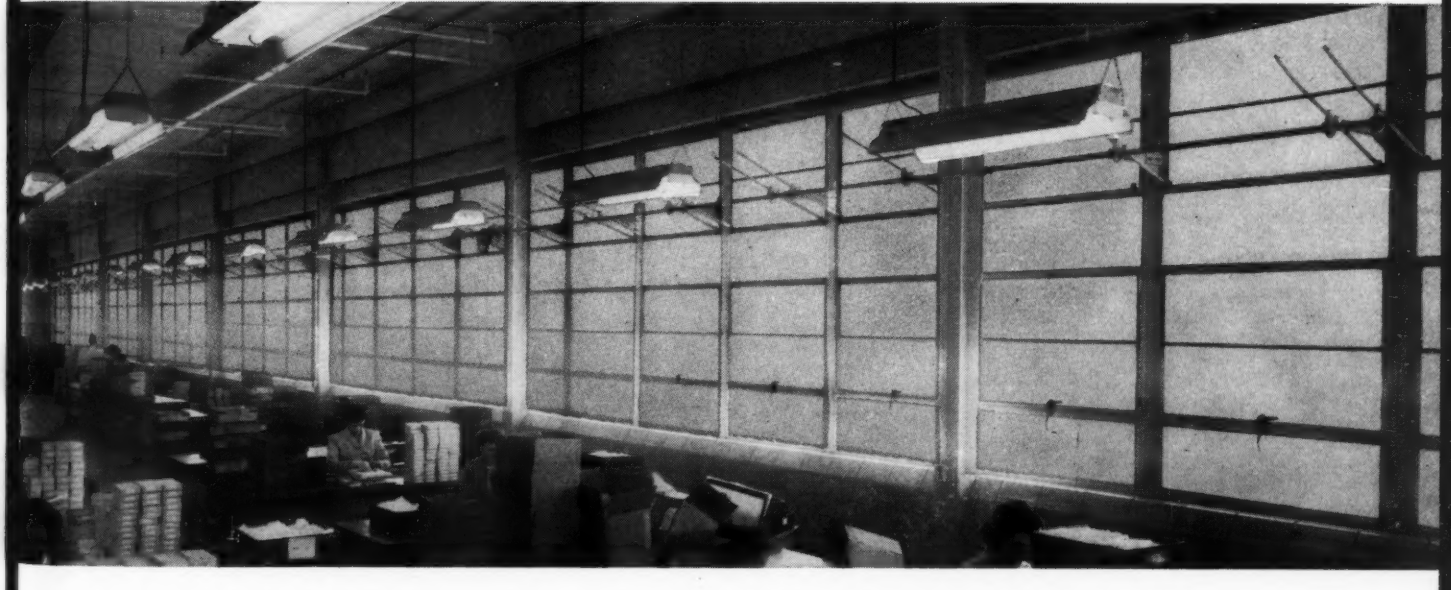
MOVING SIDEWALK — A conveyor that will carry passengers around curves, up and down inclines, and in two directions has been demonstrated by Hewitt-Robbins, Inc. It is a prototype for three installations scheduled for the Dallas airport in 1957.

THROUGH THE TRANSIT — More than 100 cities have worked up plans for extensive urban renewal projects . . . . Old Familiar: harnessing the fabulous tides of Passamaquoddy Bay may be studied again. The Senate has approved a $3 million appropriation for this purpose; the House is still considering . . . . $1¼ billion of highway construction got under way in Michigan last month with the awarding of the first contracts in a 10-year program . . . . The Urban Land Institute has issued a 32-page study, "Redevelopment for Industrial Use." $3.00 from 1737 K St., N.W., Washington 6, D. C. . . . . Mr. I. A. Benjamin of Granco Steel Products Co. told an American Iron and Steel Institute audience that galvanizing the reinforcing steel used in concrete construction will make such construction even stronger . . . . The Institute recently announced that nitrogen is being found an increasingly valuable alloying element in developing new steels for jets, gas turbines, and atomic energy applications.

# Bring in lots of daylight



# Filter it through Frosted *Aklo*® Glass



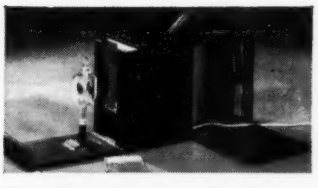
# ...best light for good workmanship

Eyes were made for daylight. People feel good in it. But two things can keep it from being ideal . . . glare and sun heat.

That's the "why" of Frosted *Aklo* Glass. It softens and diffuses transmitted daylight, reducing glare of direct sun, bright sky and dazzling reflections. And *Aklo* is a subdued blue-green color—just naturally relaxing to eyes.

*Aklo* Glass absorbs sun heat as the light passes through —reradiating much of it back outdoors. *Aklo* Glass in ¼" thickness shuts out as much as 44% of the sun's radiant energy, and it looks cooler, too.

This all adds up to better daylight for good workmanship, more comfort, better employe relations and reduced air-conditioning costs.



**PHONE FOR THIS TEST**

A call will bring a radiometer demonstration kit to your desk. It shows you how *Aklo* Glass reduces glare and sun heat. Call your L·O·F Glass Distributor or Dealer listed under "Glass" in the yellow pages of your phone book. Or write to Libbey·Owens·Ford Glass Company, 608 Madison Avenue, Toledo 3, Ohio.

**AKLO GLASS** **FILTERS DAYLIGHT**

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# ATOMS IN ACTION

NEW YORK UNIVERSITY'S College of Engineering will inaugurate a graduate program in nuclear engineering beginning in September, including both full-time academic courses and evening courses for men in industry. The college also plans to acquire, subject to AEC approval, a sub-critical reactor for use in training physicists and engineers. The reactor would use polonium and beryllium as a neutron source, and would go into operation this fall.

THREE MINNESOTA FIRMS, Northern States Power Co., Minneapolis-Honeywell Regulator Co., and General Mills, Inc., have established a joint organization to "evaluate and further nuclear developments of interest to the state and its industries." It will be known as the Minnesota Nuclear Operations Group.

A COORDINATED INDUSTRIAL sales program for nuclear research reactors, inaugurated by the Atomic Power Equipment Department of General Electric Co., will enable the company to: prepare reactor specification according to research requirements; prepare hazards summary report to AEC; build, install, and start up the reactor; and provide continuing reactor service. GE now is equipped to sell a 30 kw nuclear test reactor, a 50 kw water boiler reactor, a 1000 kw swimming pool reactor, and a 5000 kw heavy reactor.

THE DIVISION OF CIVILIAN Application, newly created within AEC, replaces the former Division of Licensing. Harold L. Price and Dr. Frank K. Pittman, formerly director and deputy director, respectively, of the abolished Division, have taken over corresponding positions in the new Division. Also transferred are the activities formerly carried out by the Licensing Control Branch of the Division of Construction and Supply and some of the functions of the now defunct Industrial Liaison Branch of the Division of Reactor Development.

MINERVA DETECTOR CO., LTD. of Great Britain has developed a smoke detection device utilizing alpha particles from strips of radium foil to ionize a double ionization chamber. The presence of smoke permits the passage of current in an associated cathode tube, activating a relay and fire alarm.

AEC'S BUDGET for fiscal year 1956 includes $25 million for acceleration of power reactor development — to provide equipment and facilities needed in connection with civilian reactor projects being carried out either by AEC laboratories, by industry, or under joint auspices. This is in addition to $50 million asked for in the operating expense budget for acceleration of civilian power reactors. One general use to which the $25 million capital fund might be put is "the construction by AEC of a prototype experimental or demonstration reactor of a type which industry is not prepared to construct with private funds." Reactor Development Director Kenneth Davis furnished a specific example of what the money might be used for when he commented on Detroit Edison's request that AEC make dynamic retrenchment studies of a fast reactor core. "This is the type of development program we would intend to carry out sooner or later anyway . . . We had thought perhaps on the order of $2 million of the $25 million might be required to construct the facilities."

FOR YOUR ATOMIC ENERGY file, Reinhold Publishing Corp. has recently published the book "Materials for Nuclear Power Reactors," by Dr. Henry H. Housner and Stanley B. Roboff of Sylvania Electric Products, Inc. Aimed at management, investors, and technicians in other fields, the book gives a broad introduction to atomic fuels in layman's language ($3.50). Also, the U.S. Geological Survey has available photomosaic maps showing radio-activity anomalies detected during airborne surveys in Moffat County, Colo. and Duchesne and Uintah Counties, Utah. These may be purchased for 50¢ a copy from the Chief of Distribution, Geological Survey, Washington 25, D. C.

OFFICIAL REPRESENTATIVES of the U. S. at the UN Atomic Energy Conference in Geneva in August are: Lewis Strauss, chairman of AEC, as chairman of the delegation; Willard F. Libby, senior scientific member of AEC, as vice chairman; I. I. Rabi, chairman of AEC General Advisory Committee, as vice president of the conference; Detlev W. Bronk, president of the National Academy of Sciences; and Shields Warren, vice chairman of AEC's Advisory Committee on Biology and Medicine and director of the Cancer Research Institute, New England Deaconess Hospital. The man to contact for cards guaranteeing priority admittance to the Geneva conference halls is Mr. Adrian Pelt, director, European Headquarters, United Nations, Geneva, Switzerland. Plans are to grant admittance on a priority basis to those with a bona fide business or professional interest.

THE NAUTILUS PROTOTYPE and the actual Nautilus have generated more than 5 million kwh of electricity for their own use to date, according to Gwilym A. Price, president of Westinghouse Electric Corp . . . Twelve major English manufacturers of non-military nuclear equipment are joining forces in preparing the first major British atomic exhibit in the U. S. for the Atomic Exposition in Cleveland this December . . . Denham and Company, Inc., Detroit industrial advertising and public relations agency, has been granted an Access Permit by AEC for "restricted data relating to the civilian uses of atomic energy". . . . The Atomic Energy Commission has dropped the price of tritium, the 12-year radioactive isotope of hydrogen, from $100 per curie to $2.

# 91% are p-k equipped*

* Yes, 91% of New York skyscrapers use p-k heat exchange equipment—instantaneous hot water heaters, storage water heaters, preheaters, condensate coolers, converters, freon coolers, etc.
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# Will Nuclear Power Promote Public Ownership

CE exclusive

**ALBERT LEPAWSKY**
**University of California**

SINCE THE SCIENCE of engineering recognizes no social or cultural barriers, American technology can tolerate no bias when it grapples with the economic and political problems of public versus private power.

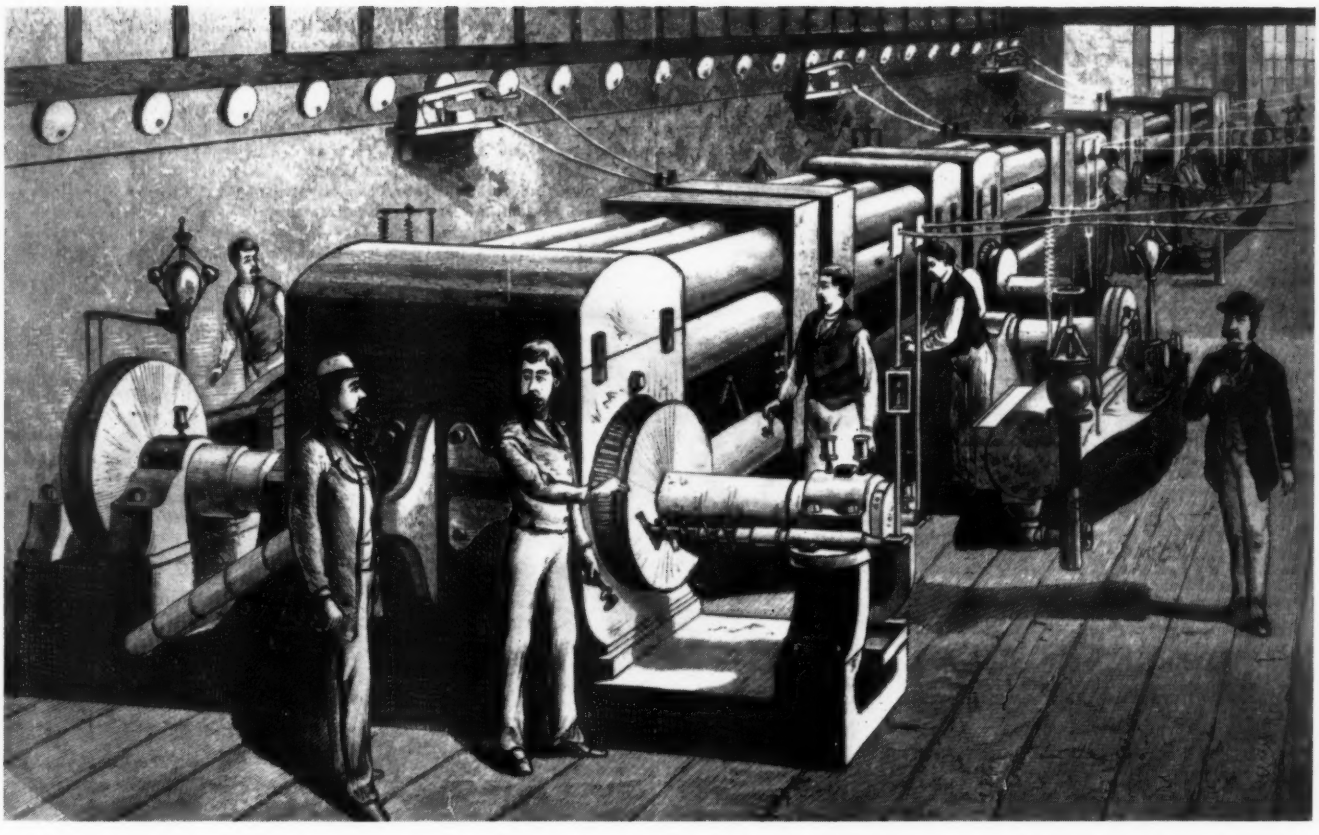
Nevertheless, individual engineers in a democratic society are bound to take different sides in these controversies. As professional consultants they must serve clients representing diverse economic points of view. As citizens, they are themselves expected to make political decisions at the polls. And as community leaders with a reputation for accuracy, their opinions carry considerable weight with their contemporaries. The engineer's best bet, here as elsewhere, is to adhere as rigorously as possible to scientific data when dealing with issues involving economic or political implication.

Among such issues at the present time are the Dixon-Yates project, the program of the Tennessee Valley Authority, the role of the Atomic Energy Commission, and the private development of atomic electricity. In analyzing such issues, we should try to isolate the technological factors as they affect both the public and private side of the American power industry during the present transitional period.

We can start with the elementary fact that technological progress in the power industry as a whole has always been a product of personal initiative or, if another term is preferred, of individual enterprise. At each decisive stage in the development of electrical energy, the inventive process has been sparked by the creative mind, the single spirit, the individual personality. The search for inventive origins becomes difficult when we try to group such creative individuals into the categories of "public" or "private" and attempt to estimate the relative impact of private power or public power upon electrical technology as a whole.

Since private companies generate more than 75 percent of our electric power and distribute 80 percent, it is natural to expect that the weight of the basic technology has sprung from private rather than public sources. Yet, this does not mean that government has avoided inventive opportunity in the power field. Atomic energy technology was a Federal Government monopoly until the recent 1954 amendments to the original 1946 Atomic Energy Act. In fact, the whole atomic energy program is primarily a product of our system of public administration. To be sure, individual scientists, highly sensitive to the military application of atomic energy, discovered and demonstrated the process of nuclear fission and urged the Government to undertake research and development at an early date. But the Government established its own Advisory Committee on Uranium (with the object of attaining nuclear power as well as the atomic bomb) two years before Pearl Harbor.

Academic institutions, private and public, continued to be employed on basic research, and industry was also enlisted on the applied aspects. Still, the atomic energy program remains a symbol of successful public enterprise. It is safe to say that most Americans regard the development of atomic energy as a highly significant technological achievement of

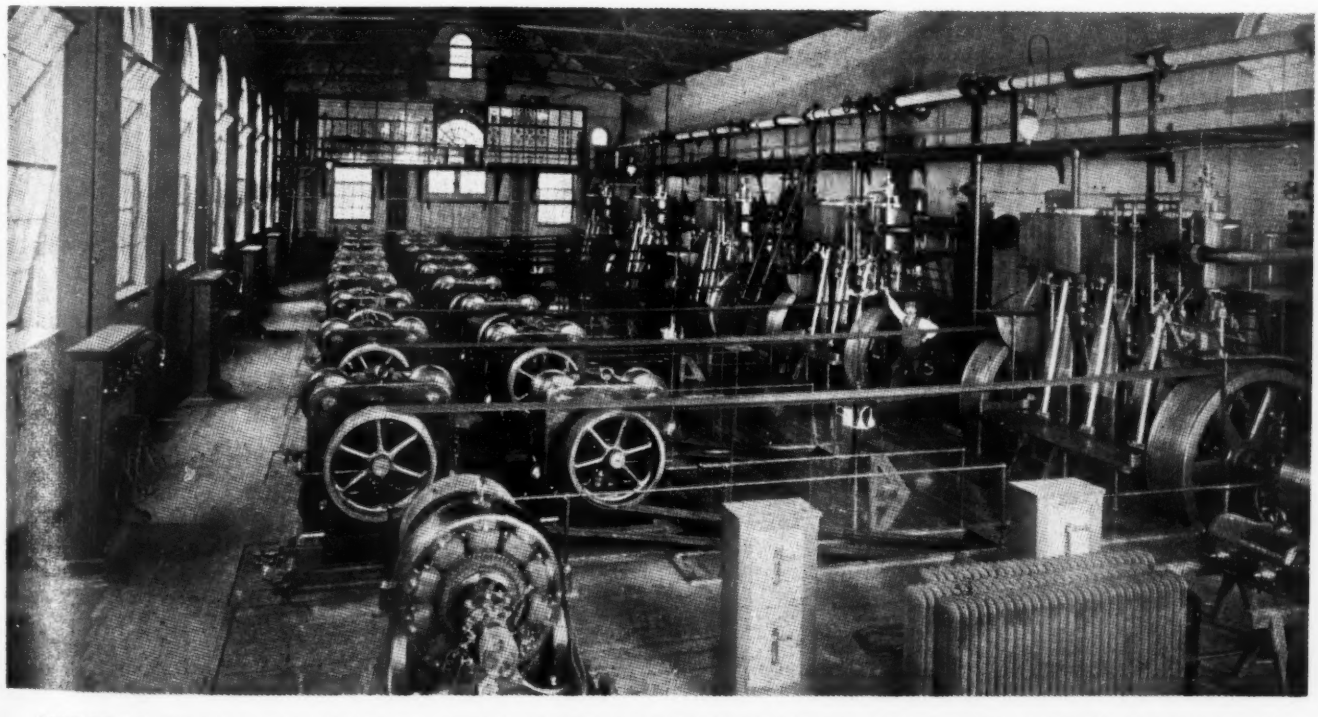


THE FIRST PRIVATELY OWNED CENTRAL STATION IN U.S. THIS IS EDISON'S PEARL STREET STATION IN 1882.

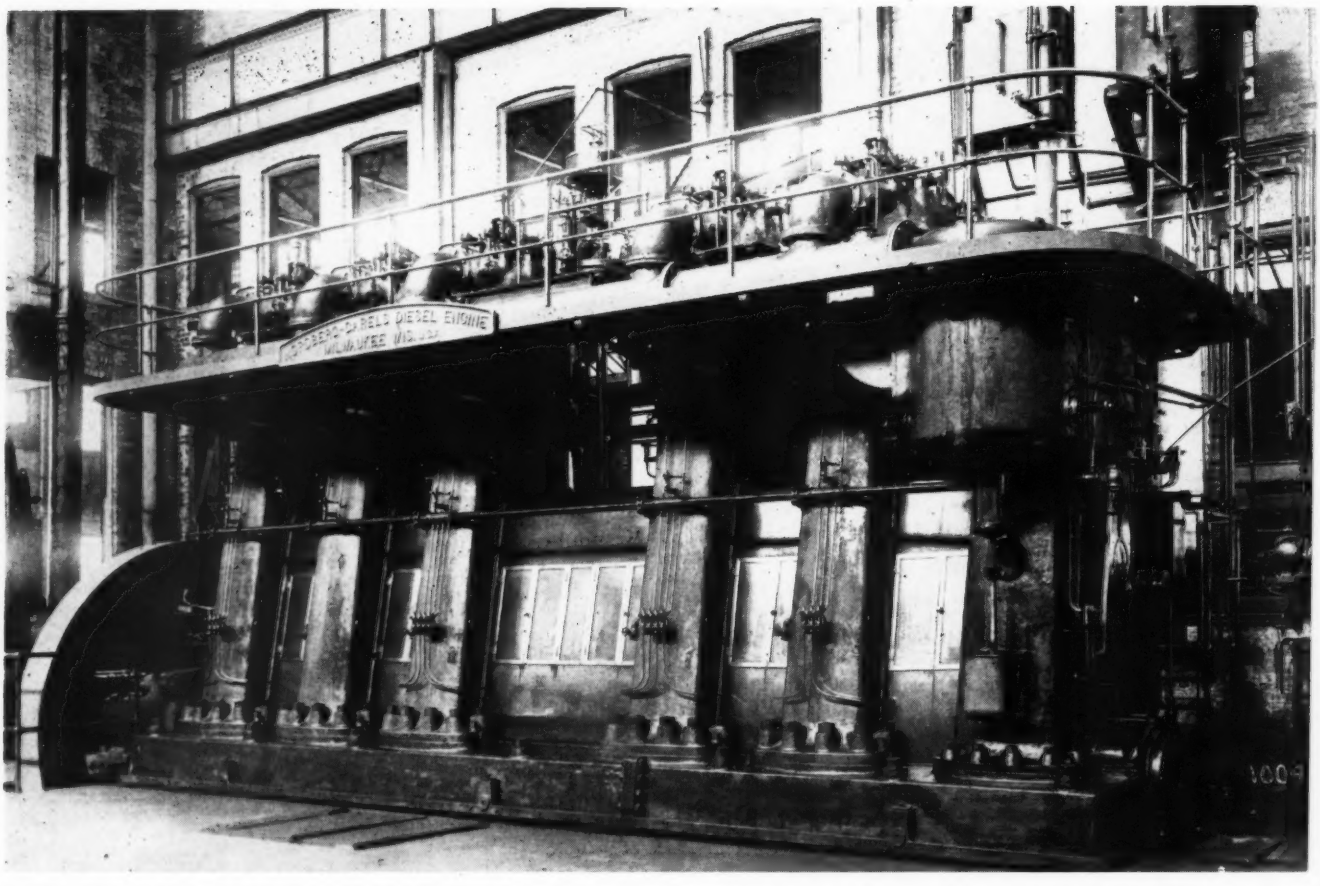
our government, or as a highly significant governmental achievement of our technology.

It was partly such public sentiment and partly also the untimely injection of the Dixon-Yates contract clauses into the Atomic Energy Bill of 1954, that lead Congress to add several public guarantees to the law as it was finally approved.

Thus, under the law, all atomic fuels are still



PUBLIC POWER WAS NOT UNKNOWN. CITY OF DETROIT GENERATED POWER FOR STREET LIGHTING HERE IN 1895.



THE TREND WAS TOWARD PRIVATE OWNERSHIP FROM 1900 UNTIL WORLD WAR I. THE DIESEL THEN PUT THE MUNICIPALITIES BACK IN THE POWER BUSINESS. THIS 1915 NORDBERG-CARELS DIESEL WAS RATED 1250 HORSEPOWER.

the exclusive property of the AEC and will be distributed by the agency under severe safeguards. The private utilities may engage in the production of atomic power only under strict AEC control and licensing. Although the AEC itself is prohibited from generating electricity for commercial purposes, there is nothing in the law to prohibit municipal, state, and other publicly-owned power enterprises from applying for licenses of their own for the purpose of generating electricity. Finally, whatever electric energy the AEC does produce in its own experimental plants, must be sold, as a matter of legal priority and preference, to municipal and other public groups.

As we enter the era of atomic energy, future prospects can be better judged if we look back at our former experiences in adjusting our changing electrical technology to the competing forces of public and private power.

One of the earliest practical demands for electricity was in the field of street lighting. Because this demand was a public or municipal demand, the electrical supply system also took an early turn in the direction of municipal ownership. That is why the glaring arc light systems, which began to illuminate our city streets in the 1870's, even while Thomas Edison was still experimenting with electricity at Menlo Park, were in some instances municipally-owned. Municipal arc lighting systems in cities like Detroit, Chicago, and Allegheny (later Pittsburgh) lasted until — and in some cities long after — Edison invented the incandescent lamp.

When, in 1880, Edison applied for the first American patent for his electrical distribution system based on what he described as the "electric lamp consisting of an incandescing material hermetically sealed in glass," the immediate effect was for private electricity to supplant the small amount of municipal electricity that had already appeared in our cities.

Private power thrived at this time partly for technological — and not purely for economic — reasons. Actually, the bankers of the Gilded Age responded quite cautiously to Edison's pleas for private capital. During this early experimental period the central generating station could serve only about one square mile of territory. To electrify such small districts, Edison could not easily have obtained the backing of municipal authorities even had he wanted it. The City Fathers of this period naturally were interested in lighting up the streets of their entire city less glaringly, but they could not very well electrify the homes or businesses of one section of the city in preference to another. Employing what private capital he could command, therefore, Edison laid out his own neighborhood

THE FEDERAL GOVERNMENT GOT INTO POWER IN A BIG WAY BY BUILDING HYDROELECTRIC PROJECTS.

projects in and about New York City and elsewhere.

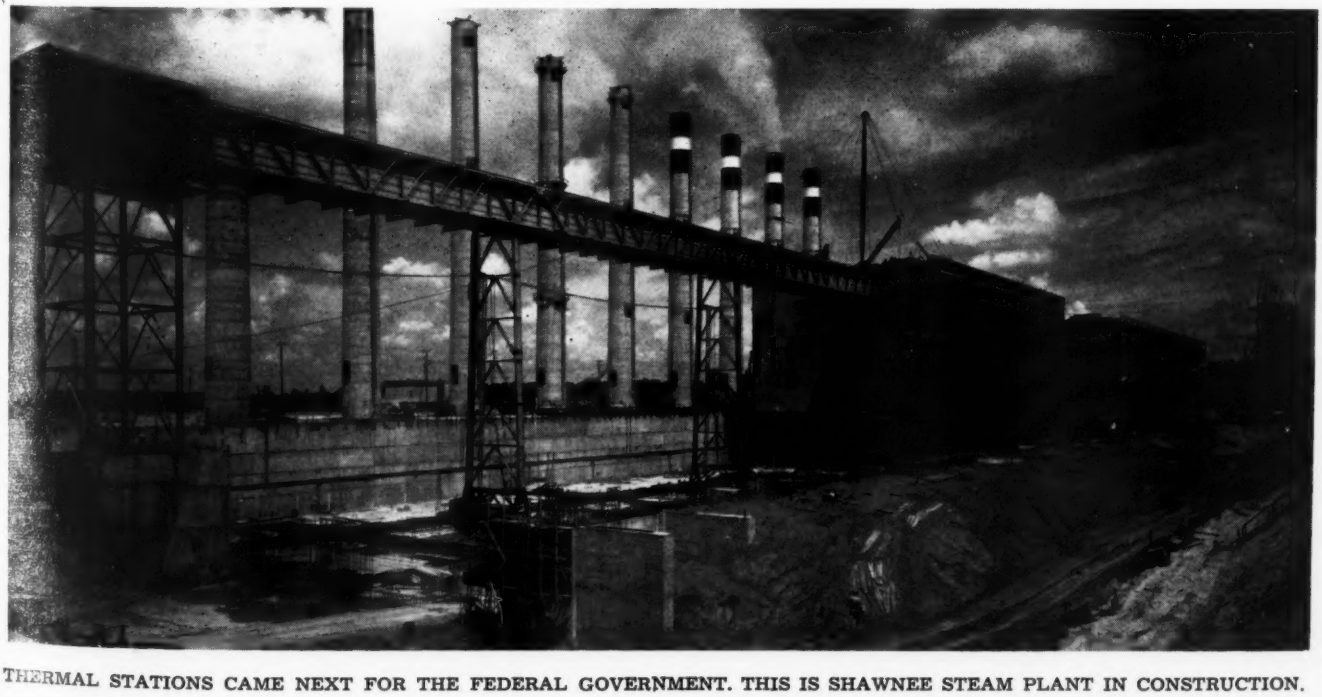
Although the first round went to the private utilities, the square-mile electrical technology of that period did not completely preclude public power. On the contrary, municipally-owned electrical enterprises continued to appear throughout the country, especially in cities whose built-up areas fitted into the square-mile limits of the central power station of the day. In fact, the number of municipally-owned projects increased phenomenally, from only 4 in 1882, to 850 in 1902, to 3000 in 1922.

### Trend to Private Ownership

However, the trend began to turn more sharply away from municipal and toward private ownership around 1900. For, in spite of their increase in number, the municipal plants supplied less and less of the nation's electricity. Their generating capacity receded from 9 percent of the national capacity in 1902, to 7 percent in 1912, and to 5 percent in 1922.

The explanation for this trend was again largely technological. For there had meanwhile appeared on the scene larger and more efficient central station equipment and the longer-distance transmission lines. These improvements greatly increased the economic area for power distribution beyond the boundaries of the ordinary city. But they placed the municipal systems at a technological and administrative disadvantage; for the legal jurisdiction of the cities limited them to their own municipal areas. Moreover, the legal debt limitations imposed upon cities prevented them from investing in the more expensive and longer-range generating and transmitting facilities.

When the literature of those days spoke of the inefficiency of public power, it was this type of technological and legal inflexibility the critics had in mind. As a consequence, the private utilities



THERMAL STATIONS CAME NEXT FOR THE FEDERAL GOVERNMENT. THIS IS SHAWNEE STEAM PLANT IN CONSTRUCTION.

began to purchase and swallow up the obsolete municipally-owned systems by the scores.

These were dark days for public power. In fact, the municipals would have been driven out of business entirely, had it not been for another technological reversal in the situation. At about the time of World War I, the small but efficient diesel powered generating unit appeared. This again made the generation of electricity economical for the restricted area of the municipal systems. It permitted them to compete once again with the privately-owned power generating utilities.

Thus did the diesel technology rescue public power during the decade of the 1920's. From 1922 to 1932, when the Republican Administrations of Coolidge and Hoover were supposed to be pampering private power, the municipal power systems — largely as a result of the diesel technology — actually trebled their generating capacity, growing during this decade at an equal rate with the private utilities of the nation.

### Federal Hydroelectric Power

Meanwhile, public power's biggest boon — the hydroelectric dam — was coming into its own. The hydroelectric dam was pioneered by private enterprise, but it was soon adopted by the Federal Government on a gigantic scale. And this happened long before the New Deal began to pour concrete into the crevices of its favorite river basins.

Since the 1920's, the hydroelectric station has in large part been the main source of public power's rise in the nation's over-all generating capacity. Today, more than 12 million kilowatts, or over 50 percent of some 23½ million kilowatts of the publicly-owned electrical generating capacity, is derived from hydro — as compared with somewhat more than 10 million kilowatts of private power's 80 million kilowatts of capacity.

Since it has legal possession of the abundantly flowing waters of our "navigable" streams, the Federal Government has exploited the larger hydro resource, while the private utilities have generally been granted the smaller hydro sites under licenses doled out by the Federal Power Commission. Only about 100 of the country's 600 commercial hydroelectric dams are today Federally-owned, but these Federal projects are the giants in the field, accounting for over 80 percent of the Federal Government's power generation, the rest being steam-electric power generated by TVA.

As in the history of the diesel technology, the development of hydroelectric public power was not purely a political matter. Even during the Republican years of 1922-32 the public hydro capacity grew from ¼ of a million to 1 million kilowatts, although most of this increase was at municipally-owned hydroelectric projects. Democrats did federalize the hydroelectric dam more intensively, raising the publicly-owned hydro capacity to 10 million kilowatts by 1952. But the Eisenhower Republicans have, even without their own "new starts," continued this trend in 1953-54 by going ahead with construction on the backlog of Democratic hydroelectric appropriations.

That the Republicans may not completely forsake Federal hydroelectric power is suggested by their own historic technological contribution to this type of public power in the form of the Hoover Dam. Hoover Dam is differentiated from the Democratic series of hydroelectric dams on the grounds that its power is not monopolized by the Federal government or by its "preferred" municipal customers. The electricity it produces is marketed by local private and public agencies rather than by national authorities, and it involves no supplementary steam generation by the Government as do the TVA dams.

### Ownership of Nuclear Power Plants

What are the precise prospects for private and public ownership as we enter the atomic age?

Technologically, we are now passing through the pilot plant stage of the atomic breeder, which is a heat source for large central stations. If we judge by what occurred when the large coal fired steam plants appeared on the scene in the early 1900's, this may mean a shift toward private power.

On the other hand, we are also now experimenting with the small and compact "package" power reactor. Since this piece of equipment would be suitable for newly settled areas or for detached communities beyond economic transmissionline range, the result might be a shot-in-the-arm for municipal and other locally-owned public power systems. This is about what happened when municipal power was revived by the appearance of the compact diesel plant at the time of World War I.

There is nothing inherent in the nuclear technology to give public ownership any particular advantage. But in view of the history of public participation in nuclear as in other energy developments, neither are there any intrinsic technological advantages for the private utilities.

Already, the industrial participation program of the AEC for the development of nuclear power includes not only a number of private utility licensees but two major public agencies as well. These are the TVA, the Federal Government's largest power enterprise, and the Nebraska Public Power District, which represents the nation's only state-wide public power monopoly.

There is no reason to assume, therefore, that the impending technological transition to nuclear energy and the recent shift from the Government's atomic monopoly to private enterprise will, of itself, seriously disturb the present balance of approximately 75 percent private and 25 percent public power in the United States. ▲ ▲

GOOD WRITING AND ATTRACTIVE LAYOUT ARE NOT THE WHOLE OF REPORT WRITING — BUT THEY ARE IMPORTANT.

# Reports Your Clients *Want* To Read

MORRIS SANDEL, JR.

THE ENGINEERING REPORT is a vital part of any engineering project. Yet, too many engineers still use the formal approach to report writing. They think the report should be a somber, heavy manuscript, fully developed through sections labeled "Letter of Transmittal," "Summary," "Introduction," "Methods," "Results," "Discussion," "Conclusion," "Recommendations," and "Appendixes." Full, formal reports of this type are sometimes needed, but they frequently do more harm than good so far as client relations are concerned.

The client is not an engineer. He has never had a course in engineering writing, so he does not know that there is a formal and accepted approach to technical report writing. He is usually not willing to go along with the game and plow through these full-length books just because "that is the way it has always been done." He wants to be able to get the idea in a hurry.

It would be foolish to go to the other extreme and suggest that all reports be condensed to one sentence or one page, but technical report writing is at least ten years behind time.

There are rules for modern report writing that will help change your reports from dull, overwritten tomes to active means of communication with sales appeal. These rules make use of the basic concepts of sales psychology to put across your findings.

This business of sales psychology is not as abstract as it sounds. It boils down to little more than making the report attractive, making it look like anyone would want to read it — and then making it readable.

### Size of the Volume

The thick report fails on every count. When a massive manuscript is put on his desk, the client's immediate reaction is to put off reading it until he has more time. That day never comes. For the client's sake, make the report thin. Perhaps he has paid for a detailed report. You have the feeling that when he sees a thin volume on his desk, he will think you have not done a full job. A lot of smart consultants have solved this by making two reports, one full and one condensed. The thin copies contain only the basic facts and the recommendations. The thick copies are filed for reference or for the study of any of the client's employees interested in the details of one or more aspects of the project. It can also serve as Exhibit A if he wants to know what you have been doing with your time and his money. If this system is used, it is not necessary to

actually prepare two separate reports. The thin report is written first, and additional data, supporting information, and detailed studies, are inserted at the proper place to make up the large copies.

### Bindings

Sales psychology also is important in the selection of a binding. Many consultants will spend a thousand dollars or more in time and expense in preparing an engineering report and then will put the final printed version in a 25¢ binder in a misguided effort to save money. Most engineers do not realize that they can have a good board binding covered with an attractive book cloth with title, client name, and their own firm name in color or gold for less than $5.00. Just look in the yellow pages of your telephone book under "Bookbinders" and call one for a quotation.

Prefabricated covers are just about as expensive as custom bindings, but there are some very attractive ones on sale. Some have acetate protectors and patented binding devices that make it possible to do your own binding yet achieve a professional appearance.

As a good example of sales psychology in bindings, look at the pocket books on the shelf at the corner news stand. Certainly, you do not want your report bound in four-color reproductions of lushly seductive sirens from the South Seas, but the lesson is there. The cover sells the book!

### Inside Appearance

The importance of appearance does not end with the cover. It is to be hoped that the client will look inside, too. The first impression will be brought about by the kind of printing used. Many reports are done on a typewriter, and the original is usually attractive enough. The carbons get worse and worse until the last two or three are next to unreadable. If only two or three copies of a report are needed, typing is the best method, without question. If six to ten copies are required, the report should be typed two or three times so that all copies are not only legible but look clean.

When ten to fifty copies are needed, the method of printing becomes a problem. There are many mechanical reproduction methods designed to handle this size run (Mimeograph, liquid duplicators, Ditto, and dozens of others) but most suffer from poor contrast and low legibility. A decision must be made as to the cost advantage of these methods when compared with offset or letter-press printing. The difference in cost is great. The cost of Mimeographing one page of a report is a matter of a few cents plus the stenographer's time. Offset printing runs perhaps $4 or $5 per page for a run of less than 500 copies. Letter-press printing, where the type has to be set on a Linotype or by hand, would cost at least twice as much. This means that a 25 page report of which you wanted 100 copies would cost about $10 to $15 if Mimeographed and about $100 to $125 if printed by offset, and $200 if letter-press printed. These figures are for printing costs only. For offset printing it is also necessary to type clean copies for the printer just as it is necessary to type the stencil for Mimeographing.

Offset printing makes an actual photographic reproduction of the typed or lettered page. Therefore, if you would have the page look like printer's type, it will have to be prepared on a special typewriter (Veritype or other office composing machine) that uses standard print rather than typewriter style characters. Office service firms in most larger cities have composing machines, and they can make excellent copy suitable for offset reproduction.

One important advantage of offset printing is that it makes no difference whether the page to be reproduced is made up of solid type, line drawings, photographs, or some combination. The method will handle all illustrations at no additional cost. All of the less expensive reproduction methods require special handling for photographs.

### Layout of the Pages

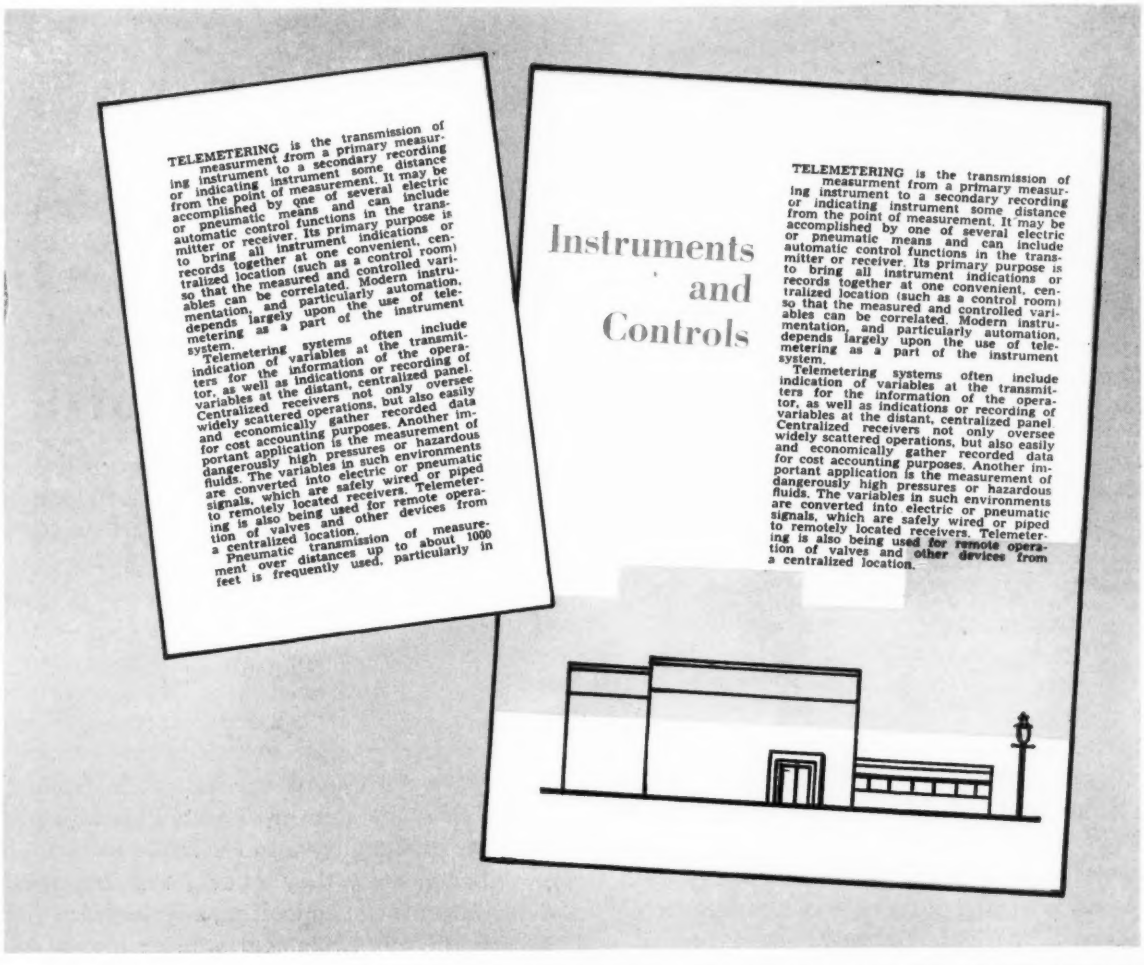
Sales psychology can be carried over into the layout of the report. One consulting firm has been effectively using photographs and drawings as title page illustrations for each section of a report. For example, the title sheet to a section of process calculations had the actual title of the section overprinted on a photograph of a section of the plant occupied by a number of stills, reactors, and tanks.

This type of presentation is most effective when two or more colors are used in printing. Here, again, cost is the drawback. Generally speaking, two-color pages cost twice as much to print as pages in black alone. It all depends on how much color is needed to communicate the idea and just whom you are trying to impress.

### The Message

If you have applied sales psychology to the binding, the reader will open the book. If you have selected the most appropriate method of reproduction and have given intelligent treatment to the layout, the reader should still be in a receptive mood and ready to read. The written message is now before him. This is the crucial moment. The client has been brought to this point merely by the application of tried and known methods used in every advertising agency. Now there comes a time when engineering must be combined with the art of writing so that the client gets the message. The most beautifully bound book and the most excellent typography will fail if the message is presented in so dull and confused a manner that reading becomes more of a chore than it is worth.

Here are some guides to writing that will carry


TELEMETERING is the transmission of measurment from a primary measuring instrument to a secondary recording or indicating instrument some distance from the point of measurement. It may be accomplished by one of several electric or pneumatic means and can include automatic control functions in the transmitter or receiver. Its primary purpose is to bring all instrument indications or records together at one convenient, centralized location (such as a control room) so that the measured and controlled variables can be correlated. Modern instrumentation, and particularly automation, depends largely upon the use of telemetering as a part of the instrument system.
Telemetering systems often include indication of variables at the transmitters for the information of the operator, as well as indications or recording of variables at the distant, centralized panel. Centralized receivers not only oversee widely scattered operations, but also easily and economically gather recorded data for cost accounting purposes. Another important application is the measurement of dangerously high pressures or hazardous fluids. The variables in such environments are converted into electric or pneumatic signals, which are safely wired or piped to remotely located receivers. Telemetering is also being used for remote operation of valves and other devices from a centralized location.
Pneumatic transmission of measurement over distances up to about 1000 feet is frequently used, particularly in
Instruments and Controls
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GOOD LAYOUT AND EXTRA COLOR AID THE PRESENTATION. COMPARE PAGES FOR READER APPEAL.

the sales psychology idea right over into the text.

*Take up one item at a time.* This applies to illustrations as well as to the text. If you find that several curves will luckily fit onto the same set of coordinates, do not give away to the temptation to put all the curves on one sheet of graph paper unless they are a family of curves in which their position with reference to each other is important. Keep the ideas separated by using a separate sheet for each independent curve. In the same sense, keep the written ideas distinct and separate.

*Get to the point quickly.* Do not say:

¶"It is next to inconceivable that this process could continue in use without some sort of substantial improvement being discovered."

When you could say:

¶"Improvements in this process can be expected."

These rules can be carried to extremes. Be careful not to go off the deep end like the report writer who felt it so necessary to separate each independent idea that he put but one idea on each sheet. This insults the reader by implying that he is mentally incapable of following normal reasoning processes.

In the same way, the writer who uses *only* simple sentences, breaking down all compound and complex sentence structures to simple statements, should be writing "Baby Ray" or "Jane and Bob" stories for tiny tots rather than engineering reports for responsible clients. This kind of writing mistake comes from a failure to keep in mind who the client is and what he is looking for. The rule of writing "on the reader's level", so often recommended by the writing teachers, is dangerous. You may misjudge his level, or the application of the rule may be impossible because the reader's level is above that of the writers. It is far better to write at *your* level. You need only be sure that you confine your vocabulary to non-technical terms or explain those technical terms necessary to the report.

Good sales psychology also requires that you:

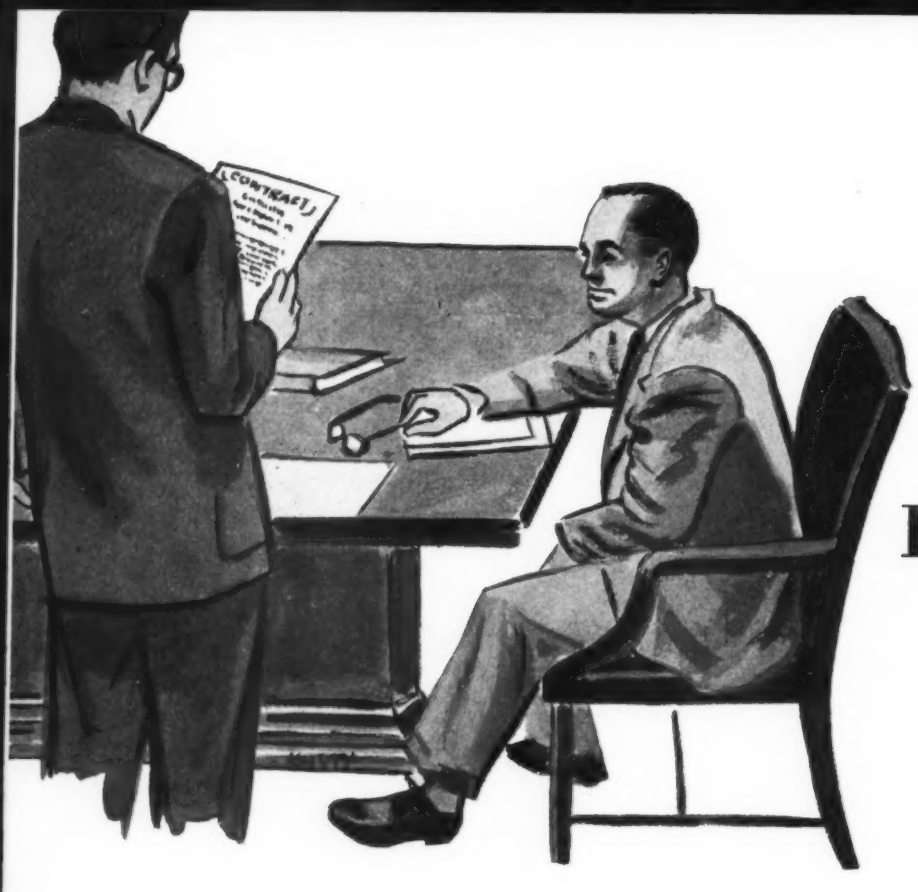
¶Be objective, avoid pushing pet projects.

¶Be honest. Be sure you know the truth.

¶Be logical. Do not draw conclusions beyond the scope of your study.

¶Be clear. Illustrate your discussion and conclusions with good word pictures or clear drawings.

If you employ these suggestions in preparation of your reports, you have a good chance of getting the client's attention, his reaction — and probably his next job. ▲▲




# Fees and Contracts for the Expert Witness

CE exclusive

**ROBIN BEACH**
**Consulting Engineer**

THE ENGINEER may appear on the witness stand as an expert witness under any one of three conditions. First, he may represent the company for which he works, serving either as a plaintiff's or a defendant's witness. Here he would be expected to serve without other recompense than his regular salary, as his investigations relating to the case, his preparation, and his conferences with associate engineers and company attorneys all would be conducted on company time. The company might conceivably express its appreciation of his services by awarding him an appropriate bonus.

A second type of circumstance exists when the engineer represents in litigation a client of his company, a subsidiary company, or a company related to his company in some other way. Here, depending on circumstances, the expert might more logically expect payment, especially if the work in preparing for trial must be done on his own time. If he were especially instrumental in helping to win the case by virtue of his effective and astute testimony, a substantial bonus could be expected.

On the other hand, the engineer who serves as an expert witness may be an independent consulting engineer, and he may take on such work as a normal part of his business enterprise. However, it is unlikely that a consulting engineer doing a satisfactory consulting business would undertake to serve as a court expert as a major part of his general practice. By and large, the income from court-expert services is wholly incommensurate with the time and effort expended, for an expert's services during trial are used almost continuously nights and week-ends.

As marginal or extraneous activities, serving in court trials as an engineer-expert offers many stimulating and challenging aspects. While not too attractive financial-wise, they offer other compensating satisfactions for the consulting engineer.

It is both interesting and stimulating to start at the cause for the litigation, seek in detective fashion the tangible facts from initial investigations, then piece together this factual evidence to make it fit a pattern. Formulating from the evidence a tenable theory for the cause, making all this clear to the attorneys, and finally, serving on the witness stand with credit and distinction, all combine to engender a feeling of satisfaction and well-being.

### Setting the Fee

For many decades, starting well before the turn of the century, the fee of $100 per diem had been considered a minimum standard rate of pay for consulting engineers. A justifiable increase in per diem rates has taken place since the early '40's. The minimum fee for an experienced engineer-expert in court cases, on a nation-wide basis, is now at least $150 per diem. Any experienced specialist of the professions —doctor, psychoanalyst, lawyer, dentist, or consulting engineer who does not receive $150 per diem for his services would seem to be seriously lacking in proficiency or professional aggressiveness.

Over the years, the engineer-expert witnesses have not always been given their due credit by lawyers. Lawyers seem still to classify engineers as glorified electricians, mechanics, or surveyors. In particular, lawyers seem to resent the standard per diem fees charged by engineers for their specialized services as expert witnesses, which standards ap-

proach their own scales of pay from court services.

A per diem fee should also include some reasonable limitation as to its per diem time span. During trials, the expert witnesses are almost invariably called on to attend evening conferences with their lawyers and principals. These meetings generally start directly after the day's adjournment of court and, with time out for dinner, they may continue on important cases night after night until 11:00 PM or later. No one has the right, nor should anyone expect, to commandeer another's services into hours far beyond the conventional day without paying a prorated hourly fee for the additional time. For the hour or two up to an early dinner at 6:30 or 7:00 PM, it would seem petty to charge for this overtime, but for hours after dinner, time should be recorded and billed.

These extra hours are important ones. During major court cases, the attorneys generally arrange to have available two or more court stenographers who work in shifts of one or two hours. The stenographer who is out of the courtroom types several carbon copies of the record of testimony taken during the preceding courtroom shift, thus making available to the attorneys transcripts of the entire day's testimony by 6:00 PM or earlier. Hence, during the evening conferences, the lawyers can dictate to their office stenographers a digest of the day's court record, formulate questions with the help of the expert, and discuss strategy for the next day in court. Generally the questions formulated the night before are reconsidered the following morning in the attorneys' offices before going to court.

On one court case I was in conference with the lawyers every day from 8:00 AM to 11:00 PM for five consecutive weeks except for Sundays—when the starting hour was delayed until 10:00 AM.

### Professors as Expert Witnesses

When lawyers are looking for an engineer-expert who is believed to be especially qualified for their current court case, they often turn to the neighboring colleges of engineering in seeking their desired prospect among the specialized members of the faculty. The engineering colleges provide a natural locale of scientific talent. Actually, the professors and deans constitute by far the major number of expert witnesses.

The specific reasons for the selection of faculty members as expert engineering witnesses are more or less apparent:

¶ They are expected to qualify with regard to their knowledge basic to the court case should this fall within the domain of their teaching experience.

¶ Because of their teaching experience the professors present less of a gamble to the lawyers when called upon to explain technical theory to the court or answer questions on cross examination.

¶ The positions, titles, and degrees of professors may sound imposing to the members of the jury and command high respect.

¶ There is an implied kindred association with the good name of the university in which they teach.

¶ Time schedules for the professors on court cases are sufficiently mobile to accommodate meetings with lawyers for day conferences and for time in court by special arrangements with associates.

### "Cutthroat" Rates

Since the income to the professors from court cases comprises unanticipated bonus returns, they are not always inclined to adhere to accepted standard of per diem fees of consulting engineers (these departures from accepted fee practices are frequently referred to as "cutthroat" rates or as plain "chiselling").

One eminent professor was widely sought after by lawyers. He reveled in court cases to the extent of appearing so often on the witness stand in so many widely-variant types of cases that he was once challenged by opposing counsel as being "an expert on all subjects." His per diem fee on all court cases was about half the prevailing fee, but with it went a subtle proviso in his contract—catching many lawyers off-guard—that he be present in court during every day of trial. This, he insisted, provided him with the advantage of knowing first hand all the evidence offered up to the time he was called to the witness stand, and second, it assured that he would be in court to serve as a rebuttal witness or to aid his counsellors in framing questions for cross examination. It also provided him with a higher total fee despite the lower per diem rate, but he never stressed that point.

Where qualified, experienced engineer-experts are called out of town on trials, and are thereby prevented from returning home evenings or keeping abreast of their office affairs, the per diem fee should be substantially increased to $200 to $250 per diem. This increased fee is justified for out of town work.

Expenses relating to the investigations, preparation of reports with their drawings and illustrations, laboratory and research studies, travel expenses, equipment for court demonstrations and exhibits, all are chargeable to the case under the contract clause, "per diem fee plus expenses." Where unusual expenses are incurred, as in making models for court exhibits or in conducting extensive laboratory tests, these projects first should be discussed with the attorneys and their approval obtained before proceeding.

### Preparing the Bill

In billing charges for time and expenses, several avenues of approach are obvious—some commendable and some undesirable. Billing is best accomplished on the ad interim basis. A bill should be rendered following the investigation and submis-

sion of the report, provided this phase of the preparation can be completed promptly. If not, billing "on account" may be made whenever the amount becomes appreciable, say $1000 or so. Frequently, this early stage of the preparation drags along for months or even years, and the expert should not be expected to go long without pay. By the time the case comes to trial, the expert should be fully paid for services rendered to that date.

An expert witness would be unwise to go into court until all bills have been paid for his time and expenses incurred during the preparation of the case. In other words, the complete investigation, its report, and conferences relating to preparation for trial, comprises one major part of the expert's services for which he should be promptly paid after billing. His time and expense while on the trial comprises the other major part of the expert's services.

It is best to establish a defense against the many calls by attorneys for expert work in connection with run-of-the-mill negligence cases by requesting a $1000 retaining fee which is charged off on the per diem fee basis. For example, if the per diem fee is $250, then the $1000 retaining fee would cover four days of service. If the case does not warrant paying this minimum fee, the lawyer would be prompt in saying so, and, if the case is of such small calibre, it is likely to be more of a nuisance to the engineer than an asset.

Furthermore, having several minor court cases in the offing keeps the engineer in a constant whirl of uncertainty, aggravation, and frustration, whereas one major court case progresses more or less smoothly into trial. Also the returns of income from the single major case may outweigh several times those from a whole series of small cases.

### Contingency Negligence Cases

A contingency court case is one involving personal injuries or death resulting from alleged negligence of the defendant in which a lawyer agrees to take a plaintiff's case on a percentage fee of any settlement. Different states have regulations regarding the proportion of the court award that may be shared with the lawyer for his services and expenses in conducting the litigation. Usually this percentage is based on the magnitude of the case. That is, if the injuries are very serious, and there is a likelihood of a large award, the lawyer's contingent percentage fee is proportionately smaller. In general, however, the attorney's percentage fee ranges from 25 to 50 percent of the recovery. The lawyer's fee is contingent on the outcome of the trial and may be nothing at all if the case is lost.

Obviously lawyers are very careful to appraise the prospects of their probable success in winning a contingency court case before they agree to accept it. Their success in remaining solvent is dependent on how accurately they appraise the probabilities of winning these cases. In their contingency negligence practice, they are schooled to close scrutiny of their expenses, and in their dealings on fees with expert witnesses, they are tightfisted and sometimes petty and small. Even in winning awards as large as $40,000 to $75,000, lawyers who operate on the contingency basis frequently contest an expert's bill that exceeds $600 to $800. They frequently seek a reduced amount through compromise.

Some major court cases, in which the litigation may arise from causes other than negligence, are also contracted on a contingency basis. These cases commonly arise where machinery is insured against failure or damage from one cause or another and then premature failures occur. The company owning the machinery is paid for its loss in compliance with the terms of the insurance policy. The insurance company in turn, initiates subrogation litigation against the manufacturer of the faulty machinery for reimbursement of its loss through failure of the equipment to live up to the manufacturer's warranty. Such subrogation suits for large and expensive machines can involve millions of dollars, especially where the outage of service caused by the failure entails a large and costly loss of earnings. Lawyers who are specialists in subrogation law practice may enjoy large financial returns from their successfully prosecuted cases, but here again the expert must make sure of payment for a lost case.

### Contracts and Their Terms for Court Experts

The objectives of a contract between the engineer-expert and the lawyer or principal who employs him may be combined very simply and directly into a three-part agreement. It can be written in letter form as long as the terms of understanding are specified clearly, briefly, and logically. The principal objectives of the contract are:

¶ To present with unmistakable clarity the specific terms making up the basis of employment.

¶ The inclusion of a statement specifying that the attorney guarantees the obligation.

¶ Obtaining the attorney's signature to the document to bind him personally. If he does not or will not sign the agreement, then he will be deemed merely an agent of the principal or principals in the case. Then the expert must look to the principal for payment of his fee.

### Terms of Employment

In specifying the terms of employment, the services to be rendered should be generically enumerated. These may comprise several items:

¶ An investigation and inspection of the premises where the event occurred for the purpose of ferreting out all of the available facts.

¶ Assisting the attorneys in interviewing and taking depositions of witnesses or others familiar with matters important to the case.

¶ Conducting tests, experiments, or research to reveal or confirm data related to the case.
¶ The formulation of a tenable theory to explain the cause of the happening.
¶ The preparation of a comprehensive report together with illustrations and conclusions.
¶ The preparation of appropriate illustrations and exhibits such as enlarged photographs, model drawings, and tabulated data, for use before the court.
¶ Conferences with attorneys and associate expert witnesses to render technical advice in preparation for court trial.
¶ Testifying in the trial and otherwise assisting the attorneys during trial.

The terms of employment dealing with fees, expenses, and schedules of payment should be carefully and amply specified. These provisions may be simple or complex, depending on the nature, duration, and involvement of the litigation. They may involve various related elements as follows:
¶ Setting of per diem fee for all services of preparation for trial up to the time of arriving at the place where the trial is being held.
¶ Setting of a per diem fee (if this is at a different rate) for services starting at arrival where the trial is being held and continuing at this rate until the expert has completed his court services.
¶ Agreement as to method of handling ad interim bills for time and expenses up to the time of start of the trial.
¶ Agreement on the payment of a retaining fee at the start of the litigation as a contract binder.
¶ Provision for submission of the final bill at the end of the trial.

To illustrate the terms of employment it is understandable that where the case is located within commuting distance of home, the expert may charge the same per diem rate both for the initial investigation, the subsequent preparation for trial, and for the trial itself. He may charge, and reasonably so, a somewhat higher fee for his time in court at the trial — for example, $150 per diem for preparation and then $200 or $250 during his time in court. Here it must be remembered that the expert witness is paid for his time and knowledge — never for his testimony.

If the expert must travel out of town to the scene of the happening in order to conduct his investigation but can return home each day, his normal per diem fee is in order providing his travel time is during normal working hours. However under circumstances where he cannot return home evenings, he should provide for a substantial increase of his per diem fee to perhaps $250. The travel time both ways would be charged at the $150 per diem rate on this assumed schedule of fees.

Sometimes one encounters an engineer-expert who obviously overrates the value of the services he is employed to perform in a court case and who may request an obviously excessive fee. The lawyer generally can determine the value of such an association, and, in some instances, seemingly excessive fees are warranted. For example, an eminent bridge designer who has an income of $100,000 per year earns about $400 per day, and he is justly entitled to ask a per diem fee of $500. It is the lawyer's privilege to use the services of a less famous consultant if he chooses. The most eminent authority is not always the most effective witness, and the lawyer knows this.

### Responsibility for Paying the Fee

While lawyers usually appreciate particularized terms of employment and billing, they sometimes seem to resent a request for a different rate for

*Henry P. Haverfield* CONSULTING ENGINEER
SPRINGS POINT, NEW JERSEY

July 3, 1955

Mr. H. B. Henderson, Attorney
Henderson, Smith and Henderson
Brookmont, Illinois

Dear Mr. Henderson:

The purpose of this letter is to confirm my understanding of our agreement (by telephone) of yesterday whereby you retain me to render the following professional services:-

1 - To investigate the scene of the explosion at Eldridge Products Co., obtaining all available data, including supporting data as needed from tests, experiments, or research, for determining the possible cause of the explosion, and the preparation of a technical report based on the above findings.

2 - To provide technical services in aiding the preparation for trial, and to give expert testimony and assistance to the counsellors at the trial.

For my services in this matter, it is understood that I shall receive the sum of $150.00 for each day spent in preparation, as outlined above or otherwise requested, as well as the sum of $200.00 for each day spent in attending court, my expenses for travel and living, and incidental expenses for preparing court models, exhibits, and other visual aids, as requested. Also it is understood that you will pay me a retaining fee of $1000.00 with this contract to be credited on the final bill.

It is also understood that you guarantee payment of the obligation incurred by these services, as outlined above.

If the foregoing statement is satisfactory to you, kindly sign, and have your client sign, at the place indicated, and return this letter to me, keeping the enclosed copy for your file.

Very truly yours,
*Henry P. Haverfield*
Henry P. Haverfield
Consulting Engineer

Approved:
*H. B. Henderson* Attorney
*J. R. Ross* Client

SIMPLE LETTER FORM CONTRACT FOR USE OF EXPERT WITNESS.

out-of-town services and the stipulation of a retaining fee. Despite the fact that lawyers conceived the term "retainer fee," they often feign ignorance of the term when they become the "party of the second part." If the terms are not resolved in a clearly expressed and definitive written contract, the request for a "retainer fee" may be interpreted by them as a "flat fee" agreement for the entire case. The flat fee should be avoided. It becomes a snare and delusion which results in a financial loss to the expert.

If the attorney will not guarantee payment of his financial obligation to the expert as outlined in the contract, he is either not the principal in the case or he is irresponsible and untrustworthy. If he is not the principal to whom the engineer should look for payment, the lawyer should then say so and help him to arrange the contract to the mutual agreement of both parties. If the lawyer is the principal and he will not sign the agreement for the engineer-expert, obviously the undertaking should be given no further consideration.

Sometimes in litigation involving electric utilities or large manufacturing companies, as many as forty or more insurance companies may comprise the principals to whom the expert must look for payment of his bill—their attorneys acting only as agents. In such instances, a loss committee or an association may represent all the insurance companies. They should sign the contract and make it binding on each member company.

After an engineer has successfully served in a few court cases as an expert witness, he will quite likely be sought by attorneys for such services, especially if he lives in a large urban area. If he attempted to accept all of these offers for his expert services, his life would soon become a confused existence, punctuated with lawyers' schedules, conflicting court appearances, and a turmoil of unpleasantries. Hence, he will find that he should use increasing discrimination in deciding which court cases he wishes to accept. The decisions could be predicated on accepting those opportunities that return the maximum income, but he will soon discover that such decisions do not always bring him the most satisfaction for the work done.

Some of the factors with which the expert will find himself wrestling to determine whether he is interested in taking a case offered to him are:

¶ Does he like the case as he listens to the lawyer explain its merits and problems?

¶ Does he feel that he would enjoy working with the attorneys and the principals in the case?

¶ Does he firmly believe he is qualified for the case not only on the basis of his theoretical knowledge but by virtue of his experience?

¶ Does he feel that he has ample time to prepare for the case to his entire satisfaction?

¶ Does every phase of the case seem to him legitimate, honorable, and above board so that by accepting his part in the trial he will not injure his engineering reputation?

¶ Would he feel equally disposed to take part on either side of the case were it offered to him without feeling that his honor might be impugned?

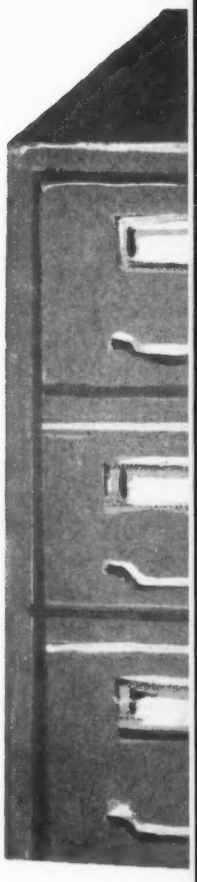
It is important to keep one's association with a court case in strictest confidence. In one court case involving a $100,000,000 suit, I was retained by the defense attorneys. Before the trial was scheduled, I was approached at various times by four independent firms of lawyers to serve as an expert witness, each group of lawyers representing special phases of the plaintiff's interests. Obviously I did not wish to reveal the fact that I was serving as a witness for the defense, as the disclosure would have detracted from the surprise element of the defendant's case. It was necessary to tactfully decline the individual requests of each of the four groups of plaintiff's attorneys to serve as their expert, without revealing the slightest indication that I was already retained on the case. This is part of the ethics of testifying as an expert. ▲▲

*This is the last of five articles by Mr. Beach on the subject of engineers as expert witnesses. Tear sheets of the four previous articles are available from the editors.*

"YOU'LL THANK ME FOR THIS UPON THE REALIZATION THAT YOUR INTERRUPTIONS COST YOU A GOOD CHUNK OF THE $200 PER DIEM YOU'RE PAYING ME. . . . . .

# Your Clients Need Help With Automation

C. E. EVANSON, President
T.A.B. Engineers



THE CONSULTANT MUST HAVE ON HAND A GOOD FILE OF BACKGROUND INFORMATION ON AUTOMATION.

CONSULTING ENGINEERS — whether they are individual consultants or are part of a large staff of engineers — have a definite and responsible role in automation. Consulting engineers contributed materially to the evolution and growth of the mechanization era leading up to automation. It is only natural to expect them to continue to contribute during the transition from mechanization to automation.

### Types of Consultants

In the field of automation, consultants can be divided into two groups: (1) general practitioners and (2) specialists. The general consulting firm usually consists of a moderate to large staff with special talents in several fields of engineering, yet with broad experience in many industries with diversified problems. Such a firm can handle complete engineering appraisals and programs, calling upon its own staff specialists as well as independent consulting specialists. While the general consultant is concerned with details of appraisals, design, and other engineering work, his primary function is to look at a project from an over-all point of view; help the client set a basic course; and coordinate the job.

On the other hand, the consulting specialist offers a complete and very thorough service on a specific phase of engineering. In the latter group are the architects, product design consultants, warehousing consultants, and others whose area of activity is purposely confined to a narrow sector. There are a number of ways in which both general and special consulting engineers can fit themselves into the overall automation picture.

### Clearing House for Information

It is the duty and responsibility of consulting engineers to collect and assimilate the vast amount of technical and business data available from various sources. The consultant's office must be a store room of information and a clearing house for all of the intelligence pertaining to automation. The general consultant will, of course, be concerned with the broad aspects of the subject while the specialist will be interested only in his own field.

A number of sources of information are available to the consulting engineer. Some of the best contemporary information is to be found in the leading magazines in the fields of automation or through periodicals that are concerned with specific phases of automation. These publications impart, through

their editorial features, up-to-date information on the theory, practice, and potentials, of applied automation in all type of industry.

Another important source of information is the text book, a number of which have already been written specifically about automation. Probably the greatest value in these books is their concise presentation of theoretical background and specialized information which can be used for reference by the consultant. Also, the United States Government, through such research and development programs as "Project Tinkertoy," has contributed a great deal. Much of this information is available to consultants through various Government publications or films either at no charge or at a nominal cost.

Educational institutions are almost constantly conducting research programs, and their findings are usually printed and published in pamphlet form. While this information is usually theoretical, it does help to stimulate engineering thinking along the lines of future possibilities and adaptations in the field of automation and allied fields.

Other important sources of information are engineering meetings, exhibits, conventions, and lectures. Usually these deal with one subject or one industry, but they offer a considerable amount of detailed information that can be helpful to either the general consultant or to the specialist.

### Objective Viewpoint Essential

It is essential that the consultant maintain an unbiased viewpoint to properly evaluate the automation possibilities and potentials of a given client. The general consultant will be looking at the broad over-all picture. The specialist will be focusing his attention on a specific area or field. Nevertheless, whichever it may be, the importance of the unprejudiced attitude cannot be overestimated.

One of the most delicate problems within a company is the unintentional distortion of facts, plans, and programs to suit the preferences of individuals and individual departments. For example, in his loyal enthusiasm for his own department, the production engineer will sometimes discourage action that is in the best interest of the company as a whole or encourage action that does not fit with over-all policies and plans. The same zealous spirit is felt in each department.

The result is that opinions, viewpoints, and recommendations by individual departments must be properly evaluated and, if necessary, discounted in order to effect proper balance. The plant engineering department might be highly enthused about a new program of automation and because of this it would think very fast and far ahead and would want action now. However, the production department might be particularly burdened with its own current problems and programs, and it would not be receptive to additional work and responsibilities that would interfere with current commitments. Each department would feel that it was acting in the best interests of the company. Actually, an evaluation of both viewpoints would be required.

This same analogy holds true for individuals. We, as consultants, understand that employees, supervisors, and department heads are anxious to do a good job for their company. They want to win recognition plus the accompanying rewards. Therefore, when an employee becomes highly enthusiastic over new ideas, programs, or plans, and ambitiously endeavors to carry them out, he certainly cannot be criticized for endeavoring to act in the best interest of the company by doing the best job he knows how. However, because of his own, sometimes biased, point-of-view, it is difficult for him to maintain a completely objective attitude consistent with the over-all policies and desires of the company.

Since automation is so far reaching and actually affects every function of the business, the success of any automation development program depends on an unprejudiced, unbiased point-of-view. The primary advantage of consulting engineers in their service to industry has been this unprejudiced, unbiased attitude — a part of the profession's code of ethics. Consultants' investigations, analyses, and recommendations must always be in the best interest of the company, and not for any other purpose. We must avoid any possibilities of prejudiced opinions or faulty engineering recommendations.

### Clients Need Practical Help

Once the consulting engineer has collected and accumulated valuable information on the subject, and once he has set his sights to maintain an objective viewpoint, it is then his responsibility to provide practical information, ideas and suggestions for his clients. This should not take the form of highly complicated technical information which might have a tendency to confuse even the most qualified management and engineering staff. Actually, it should be in the form of screened and digested information which can be quickly understood and readily applied to the preliminary thinking stages.

For example, clients of a general consultant will want to know some of the basic facts and concepts about automation and partial automation. They will want to know where automation has already been used in other industries and in their industry. They will want to know how automation might be applied to all or parts of their product or plant. They will want to know something of the cost of automation, and they will want suggestions on how to approach the subject. Similarly, clients of the individual specialists will look to them for information pertaining to the various details. The architect will be expected to design buildings for automation; the product designer will be expected to supply assistance on the product design requirements for manufacturing by

automation; and the instrument specialist will be called upon for control design.

In order to offer the suggestions, ideas, and the latest information available on new developments in automation — such as what others are doing and what is available in the field — it is necessary to keep such information up-to-date and have it in a form usable by the engineer's own staff and the client's engineers. This requires a system for collecting, assembling, and classifying the information in a filing system that will fill the needs of the consultant. In general, it should be as complete as possible and properly catalogued for ready accessibility. A well designed system will save both the consultant and the client a great deal of time and money, thus contributing toward early decisions. In our own firm we have developed a unique subject classification file that saves much time in producing the information desired of this type.

### Determining an Automation Program

Helping your client to find out whether he is ready for automation is a complete project in itself. Consultants must be equipped and prepared to help their clients analyze their companies and products in terms of partial or complete automation. Further, they must help them arrive at a decision as to whether or not they are ready to proceed with some type of program.

When a company has been analyzed by a general consultant, and it is found that a partial or complete automation program is feasible and practical, the consulting engineer should then assist the client in carrying out the program. In so doing, it is obvious that the general consultant must be prepared to provide the necessary engineering experience and talent for each phase of the program or he should know where that assistance can be readily obtained. We must remember that the automation program may consist of building design and construction, product design, special machinery and equipment design, office forms and procedures, process equipment layout, and other specialized activities, all of which must be coordinated in the plan.

### Selecting Equipment

In helping to apply and develop an automated or partially automated production system, the consultant must first determine the availability of standard equipment. It is not economically sound for the client to underwrite special equipment when standard equipment is available. Therefore, the consultant should maintain a large file of data on standard equipment adaptable to the requirements of automation. Because of the rapid development of new products and equipment of a highly technical nature in such fields as electronics, this consultant must have at his fingertips all of the information on new products that are actually designed for automation.

In the event that standard equipment is not available for an automation or partial automation program, then the consultant must be ready to design special equipment and machinery. No longer is it a question of replacing labor with some mechanical device. Instead, with the new concepts of automation, the designers must be prepared to incorporate servo mechanisms, electronic computors, and signaling and actuating devices. The consultant must, therefore, have available machine designers who have had experience in automation systems.

It should be remembered that the designing and building of new structures and equipment and laying out plans for automation requires a visionary, yet realistic and practical approach. To be able to offer clients the very latest in engineering and design thinking is important. However, the consultant should not lose sight of the fact that ideas for his client must be consistent with the over-all program for the next decade or so. To underdesign or underbuild for the sake of economy would be just as bad as overdesigning or overconstructing for the sake of an impressive project.

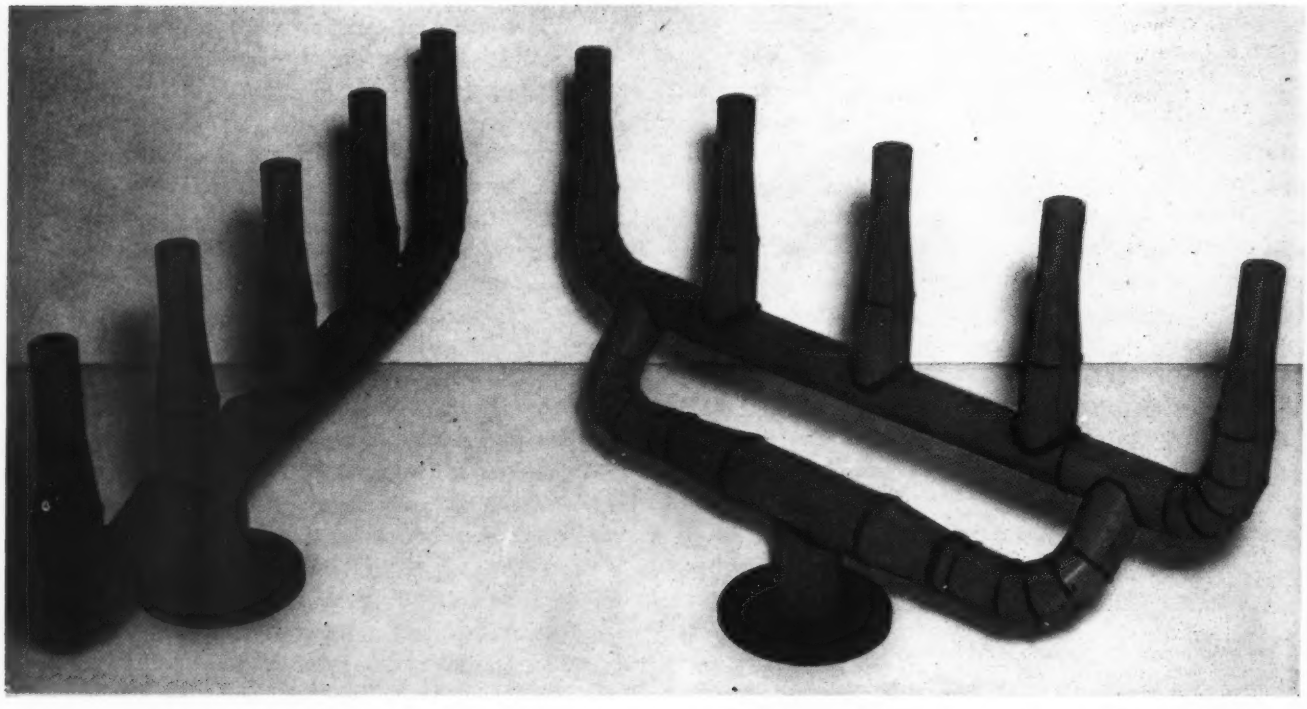
### Leaders in Automation

The final part that the consultant must play in any program for automation is sometimes forgotten, yet it is highly important. It is the part of leadership. Because of the fact that automation and partial automation are complex subjects, they may seem nebulous to management and engineering executives in industry. It is no wonder then, that the clients are somewhat dubious about their own desires and decisions and perhaps hesitant about going ahead with even the smallest plans for partial automation. That is where the trusted and respected consultant can actually be a steadying influence.

Because of the expenditure of money involved, automation programs often take on the semblance of pioneering. The fears normally accompanying business pioneering are familiar to all of us. It is not easy to move ahead continually in a fast moving world. Yet, no company can stand still. A company will either go forward or it will lose ground, and the direction it takes will depend upon management.

Generally speaking, automation or partial automation on a practical basis, is a step toward future growth and development. As in all new developments leadership is extremely important. Management, through the consultant, must have the vision to foresee the possibilities for lower costs and greater profits for strengthening the company in the days ahead. The consultant through his own avenues of information and vision must be able to look ahead and project his clients' needs into the industrial or economic picture ten, twenty, or thirty years ahead.

Once the future is pictured, the consultant can and should provide leadership in helping the client carry out his automation program. ▲▲



MANIFOLDS OF TYPE II POLYVINYL CHLORIDE PIPE ILLUSTRATE TYPICAL FABRICATION OF PLASTIC MATERIALS.

# Putting Plastics in Their Place

**JOSEPH A. SNOOK and RAYMOND B. SEYMOUR**
**The Atlas Mineral Products Company**

•

THE MODERN CONSULTING ENGINEER is expected to keep abreast of technological advances in all phases of engineering, including such less familiar concepts as the use of plastics in construction.

Like electronics and nucleonics, this branch of technology was essentially unknown 25 years ago, but it is undergoing rapid growth. At present, over 3 billion pounds of plastics are being produced annually in the United States alone, and estimates indicate approximately 20 percent of this total is being used by the construction industry. However, it is anticipated that this application will more than double within the next 5 years. It will be the responsibility of the consulting engineer to supply guidance in the proper selection, design, and fabrication of these versatile materials of construction.

## Plastics in Construction

In preparing current specifications the consultants immediate concern is to have a knowledge of the time-tested practical applications of plastics in construction. Many excellent plastic products are available for various service conditions. These include:

¶ Pipe for transporting gas, water, liquid chemicals, corrosive fluids, waste liquors, and other solutions.
¶ Coatings for finishing the wearing surface of concrete floors, lining tanks or vessels, or protecting exterior surfaces.
¶ Tile for floors or walls.
¶ Cements for joining ceramic tile or brick.
¶ Membranes for waterproofing in slab construction or as a lining under the protective brick interiors in concrete sumps, pits, trenches, and manholes, or steel vessels containing various process solutions.
¶ Tanks for storing acids, alkalies, and solvents.
¶ Fiber glass reinforced panels for use in constructing partitions, walls, and roofs of buildings.
¶ Cellular-structure materials for insulating panels against heat and sound.
¶ Paint for decorative purposes and for surfaces subjected to high humidity or corrosive fumes.
¶ Sheets for constructing stacks, hoods, and ducts for exhaust systems handling corrosive fumes, or though not completely essential, for noncorrosive services such as heating and air conditioning.

Obviously this list is not exhaustive. With the many materials available the potential uses of plas-

tics in construction are almost limitless. However, the following information on known applications, based on reliable data, may provide assistance in the preparation of specifications. The choice of generic illustrative plastic materials for specific end uses is not intended as a condemnation of any other product since various types may be satisfactory for the same conditions.

### Plastic Piping

Polyethylene pipe has been used satisfactorily for low pressure natural gas and water lines. It should not be used for moderate or high pressure service, at temperatures above 125 F, nor with solvents, such as are often present in artificial gas.

Since polyethylene is flexible and usually supplied in coils, few joints are required. Pipelines can be arranged to by-pass obstacles or to change direction without using elaborate fittings. However, polyethylene pipe must not be bent at sharp angles nor permitted to be in contact with sharp objects, and provisions must be made to compensate for its high coefficient of expansion. Sections are joined with plastic insert fittings held in place by external clamps. Pipe of this type, meeting the United States Department of Commerce's standard, is suitable for transporting potable water and is so labeled.

Corrosive fluids and wastes can be transported by Type II unplasticized polyvinyl chloride (PVC) pipe. This pipe is rigid, but it has excellent resistance to impact and good resistance to corrosives. Its properties are specified in a standard issued by the United States Department of Commerce.

Type II PVC is now available in IPS sizes up to 12 inches. The small sizes can be joined with threaded fittings, but the larger diameters require flanges or slip-type cemented fittings. This pipe can be used at moderate (but not high) pressure and at temperatures up to 150 F. It should be supported continuously when handling fluids above 110 F and at intervals not greater than 4 feet at lower temperatures. Provisions must be made for expansion in any pipeline longer than 100 feet. Type I PVC has been used for electrical conduits, downspouts, and various other applications.

For large diameter industrial waste lines, the present practice is vitrified clay pipe with hot-poured plastic joints in diameters up to 36 inches. Concrete pipe is used for larger sizes, with plastic liners or ceramic liner plate construction joined by plastic cement providing protection against corrosive solutions and fumes. Even the gases from domestic waste attack concrete pipelines.

### Floors

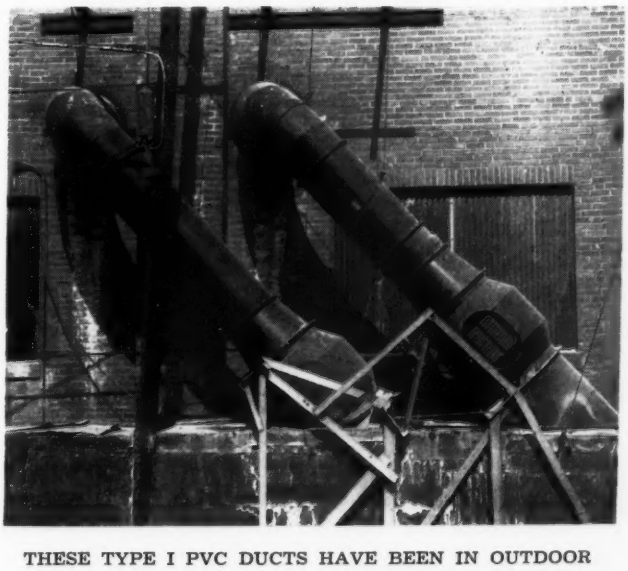
Floors in dairies, breweries, canneries, distilleries, commercial kitchens, bakeries, and pharmaceutical plants usually are concrete slabs with a wearing surface of 6-in. square quarry tile joined by furan cement. Since the floors are exposed to process liquids or cleaning agents, the concrete slab should contain a plastic waterproof membrane, and it should be sloped to drains. Levels and slopes must be specified precisely as the tile will follow the contour of the base slab.

In furan light duty floor construction, a freshly mixed red furan plastic cement is screeded onto the clean concrete floor slab using a serrated trowel. A ½ or ¾-in. thick quarry tile, whose top surface, but not edges, has been coated with a thin layer of hot paraffin, then is laid in place symmetrically while the red cement is still soft, leaving space for a ¼-in. joint.

After the red furan plastic cement has set hard, freshly mixed black furan cement is spread over the top surface to completely fill the open joints. This is accomplished by passing a trowel over the area, leaving a very thin layer of the black cement on the tile surface. The following day, or any time after the black furan cement has hardened, the surface is subjected to a direct blast of high pressure steam to melt the wax and thus remove the hard black cement from the wearing surface of the tile.

When furan light duty floors are specified, it is important to insist that the floor slab be constructed to proper grade and slope and that the floor temperatures be at least 60 F during construction. It is equally important to ascertain that no construction dirt or other foreign material is allowed to enter the open joints before the application of the black furan cement, or until the black furan cement in the vertical joints has hardened.

Heavy duty floors for chemical plants usually have a wearing surface of acidproof brick joined with a furan cement applied by brick-laying rather than tile-setting methods. In this construction, a paint coat of plastic primer is applied to the clear



THESE TYPE I PVC DUCTS HAVE BEEN IN OUTDOOR SERVICE 3 YEARS HANDLING PICKLING ACID FUMES.

concrete slab, which previously has been brought to the proper level and slope. Then a ¼-in. thick hot-poured asphaltic membrane is built up in several layers, using a straight edge and inspecting each layer to assure the absence of pinholes.

When laying the bricks, the contact edges are buttered with freshly mixed furan resin cement. The bottoms also may be buttered if a bed of resin cement is required. Joints are struck with a trowel as laid and the jointing cement is allowed to harden. Floors of this type can be placed in service a few days after completion, and they often are used in metal processing plants where corrosive plating solutions are present.

For areas where metal is cleaned by pickling in hot acid, it has been the custom to specify heavy duty sulfur cement floors. This type again must have a pinhole-free membrane on the slab. The bricks are set dry, either directly on the membrane or on a bed of ¼-in. thick sulfur cement chips, applied over the membrane if required. An open joint approximately ¼-in. wide is provided and later filled with a hot liquid proprietary sulfur cement.

In order to prevent voids, the joints are poured at various points starting at one edge of the room and proceeding to adjacent sections as soon as the first series of joints are filled to within ½-inch of the top. A second pour is made shortly after the cement has hardened and while it is still warm to compensate for shrinkage on cooling and to insure a monolithic joint. It is customary to flood the floor with the second pour and to leave the thin surface layer on the brick to be worn off with time.

### Sumps, Pits, Trenches, and Manholes

When poured concrete sumps, pits, trenches, or manholes are to be protected by brick linings, the distance between the walls at the top should be greater than the distance at the bottom. The possibility of wall cave-in is minimized with this tapering-type construction, often termed "battering."

Before setting the brick, the walls and bottoms are covered with a ¼-in. layer of hot-applied plasticized asphalt similar to that used on industrial floors. If severe, corrosive conditions are encountered or the structure will hold hot corrosive liquids for a period of time, it is often advisable to use a ⅜-in. thick triple-ply membrane consisting of a sandwich made up of a layer of plasticized sulfur cement between two layers of plasticized asphalt.

Normal installation procedure is to lay one course of the vertical wall first by buttering the back, bottom, and one side of the brick with a freshly mixed furan resin cement. Then the floor is completed in routine manner. This sequence helps key-in the vertical wall.

In both circular and rectangular recessed trenches, the building floor brick extends over the top of the wall lining in the trench. This technique, like battering, minimizes the adverse effect of horizontal thrusts. Some trenches are constructed from half-round vitrified clay pipe, laid over an asphaltic membrane coated concrete fill that has been preformed to the finished circumference.

TYPICAL FURAN JOINED TILE FLOOR CONSTRUCTION.

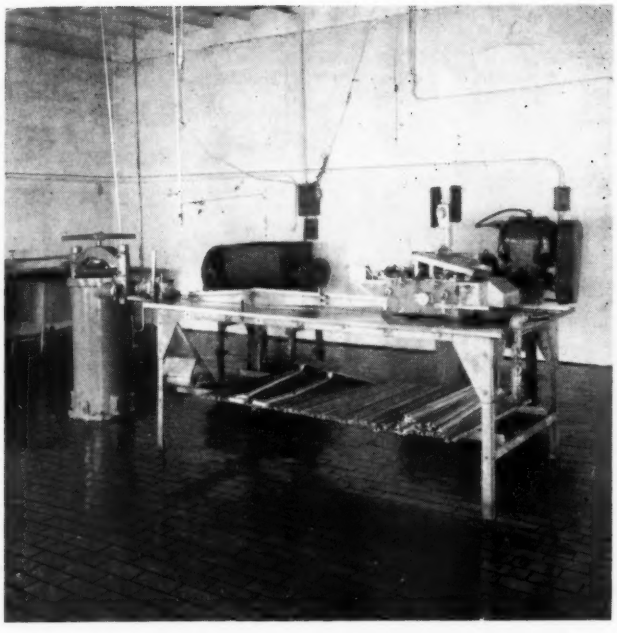
Two accepted methods are available when ceiling protection is required. The most common one is ceramic liner plates cast in concrete joined with furan cement. These liners are held to the concrete ceiling by means of dovetailed slots on the back of the plates. The other utilizes acidproof bricks joined with furan cement to provide an arched or dome-shaped ceiling.

### Tanks and Vessels

A liquid neoprene coating will protect the exposed surfaces of concrete tanks containing water or other mild corrosives. It is customary to apply a minimum of three coats in alternate black and grey colors, to insure complete coverage and freedom from pinholes. Steel tanks holding water or other mild corrosives can be protected in a similar manner, provided the steel surface is first sandblasted and solvent-cleaned to remove all rust, grease, and loose mill scale.

Tanks for the storage of acids or other highly corrosive solutions must have a sheet lining, which should be applied by trained crews using an adhesive system and heat-welding all seams. A 3/16-in. thick natural rubber lining is generally satisfactory for most acids and alkalies at temperatures up to 150 F. A 5/32-in. thick plasticized polyvinyl chloride sheet lining is recommended for tanks holding plating solutions or nitric acid.

Processing tanks subject to physical damage or elevated temperature service usually have a protective brick sheathing over the rubber lining. This



PLANT FLOOR OF FURAN JOINED ACIDPROOF BRICK.

brick lining is similar to that in other concrete structures, but in addition to battering, it is customary to bow the walls of long tanks to place the brick walls in compression. The thickness of the brick protection varies considerably and depends on such factors as: size of equipment, corrosive and abrasive conditions, possible physical damage, and temperature. Furan plastic cement is the common joint material although other types are available for special conditions.

All plastic tanks cast from furan cements have been used for many years for the storage and processing of acids, alkalies, and solvents. Some progress also has been made in the use of lightweight tanks constructed from fiber glass reinforced resins.

### Walls and Partitions

Building walls exposed to splash or fumes of corrosive liquids can be constructed with a tile lining over the masonry. The tile are set in freshly mixed red furan cement, and the open joints are filled by pointing with black furan cement. For many services, satisfactory protection is obtained through the application of three coats of a vinyl base coating to walls or overhead structures. Since this product is available in different colors, it is possible to color-code pipelines. Colored coatings also provide decorative value besides protection against corrosion.

Corrugated panels of fiber glass reinforced polyester plastic make excellent lightweight partitions. Additional strength and insulation against heat and sound can be obtained with a sandwich-type construction. The center usually consists of a cellular plastic of urethane foaming resins.

Less expensive retaining shells, such as asphalt impregnated paper, can be used to insulate tanks and refrigeration systems. The foamed-in-place plastic is poured in the void between the tank and the asphalt impregnated paper. This type of insulation also can be sprayed on walls and tank surfaces.

### Glazing

Corrugated sheets of fiber glass reinforced polyester plastics also have been utilized as outside wall and roof sections in place of glass. These panels can be completely opaque or can transmit diffused light since translucency can be controlled from 0 to 90 percent. They can be sawed in almost any shape and do not require a frame. Excellent visibility and light transmission also can be obtained with structural panels of clear plastics, such as the acrylates.

### Stacks, Hoods, and Ducts

While brick stacks joined with furan resin cements still are favored for exhausting hot corrosive fumes, plastic stacks have proved satisfactory at many installations. The plastic stacks are light in weight, require little support, and are less expensive than ceramic stacks.

Exhaust systems handling corrosive fumes at temperatures up to 150 F have included both rectangular and circular welded Type I PVC ducts. Hoods, plenum chambers, and fans also have been fabricated from Type I PVC, since it can be sawed, routed, heat-formed and welded, and produced in intricate shapes. Structures can be reinforced to meet almost any design requirement. Sheets approximately ⅛-in. thick are suitable for small duct work, but larger structures may require sheets up to 5/16-in. thick.

While completely satisfactory for systems exhausting corrosive gases, plastic structures generally are considered too expensive for applications involving mild corrosives. However, air-conditioning engineers are seeking an economical all-plastic system. Development work now underway indicates a newly designed PVC ductwork may prove to be the answer for air-conditioning and similar service conditions.

### Conclusion

The annual cost of corrosion in the United States alone is almost $6 billion. Most of the effort in combating this problem to date has been based on expensive metal alloys that corrode at a slower rate than steel. While the service life of various units has been prolonged, the annual cost of corrosion has not decreased. However, properly selected plastics, unlike metals, are not attacked by corrosives. There are many successful plastic installations in service after 20 years of constant exposure to boiling acids.

Plastics already are playing a major role as materials of construction. Their use will increase as engineers become better acquainted with their inherent advantages. ▲▲

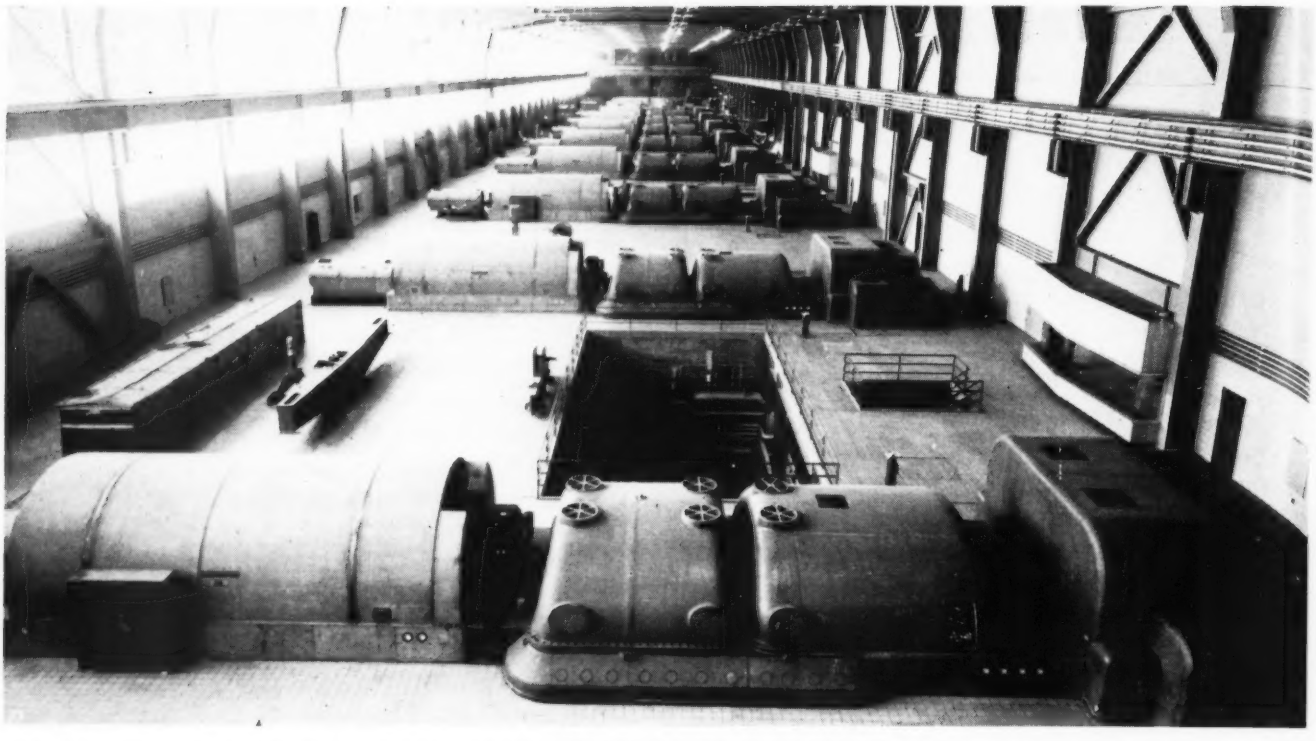


FIG. 1 — VIEW OF THE TURBINE ROOM AT THE TENNESSEE VALLEY AUTHORITY'S NEW SHAWNEE STEAM STATION.

# Shawnee's Supervisory Control System

**RAYMOND M. ALSPAUGH, Electrical Engineer**
**Electrical Design Division, Tennessee Valley Authority**

CE exclusive

Raymond M. Alspaugh studied electrical engineering at Missouri University and Kansas University, receiving his B.S. degree in Electrical Engineering from Kansas in 1928. Following graduation he spent one year in the Westinghouse Graduate Student Course, and then entered the Central Station Division of the Switchboard Engineering Department, working on switchboards for New York Rapid Transit Company, Pennsylvania Railroad, Hoover Dam, and TVA's Wheeler Dam. In 1936 he joined the Electrical Design Division of Tennessee Valley Authority, and he has worked on control and communication problems for all of the Authority's hydro and steam generating plants. Five of these hydro stations are operated from remote stations by supervisory control equipment over telephone circuits or power line carrier channels. Several of the plants also have supervisory control equipment for the control of remote substations. Mr. Alspaugh has served as Chairman of the East Tennessee Section of A.I.E.E. He has presented papers before this Section, the Georgia Tech Relay Conference, and the New York General Meeting of A.I.E.E.

MOST CONSULTING ENGINEERS are familiar with the magnitude of the Tennessee Valley Authority's new Shawnee steam plant. This station ultimately will have a total of ten turbine generators (Fig. 1) that will provide a maximum capability of 1,500,000 kw. Currently, eight of these units are in service, and the remaining two boilers and steam turbine generators are under construction.

Since the distance between the No. 1 and No. 10 units is approximately 750 feet, it was not practical to bring all of the boiler and turbine controls to a common control room. Instead, the Shawnee plant has both decentralized and centralized control systems. There are five control rooms on the turbine floor, one between each pair of units. These dual control rooms project into the turbine room as

shown in Fig. 2, providing the operators with a good view of the generating units.

### Control Rooms on Turbine Floor

In each control room, the switchboards are arranged in a split U shape, with the combustion controls and the controls for the boiler feed pumps, draft fans, and other auxiliaries mounted on a benchboard. Necessary gages and recorders are located on vertical switchboard panels behind the benchboard as shown in Fig. 3. Fluorescent lighting above an aluminum egg-crate ceiling provides excellent illumination for the operators.

Scanning type temperature recorders with alarm contacts are used to measure various bearing temperatures, and annunciator windows on the vertical panels indicate abnormal temperatures and pressures. Many of these alarms for the turbines and generators also are repeated in the main control room. Wired-type television systems transmit boiler water level readings of the steam generating units to the respective turbine control rooms.

### Separate Control Building

Electrical control boards containing the control for the governor speed-adjusting motor, exciter field rheostat, station service emergency power, the oil circuit breakers, and motor-operated switches in the switchyard are located in a separate control building between the power plant and switchyard. In designing this part of the system, switch handles of distinctive shapes and colors were selected to aid the operators in readily recognizing the functions of each switch.

Switch locations in the control building duplicate the arrangement of switchyard bays. The indicating instruments on a vertical switchboard beyond the benchboard (Fig. 4) also are in the same order as the control switches on the benchboard. Behind the operators seated at the desk, another vertical switchboard (Fig. 5) contains recording instruments for generator field temperature, generator stator temperature, and transformer temperature. In addition,

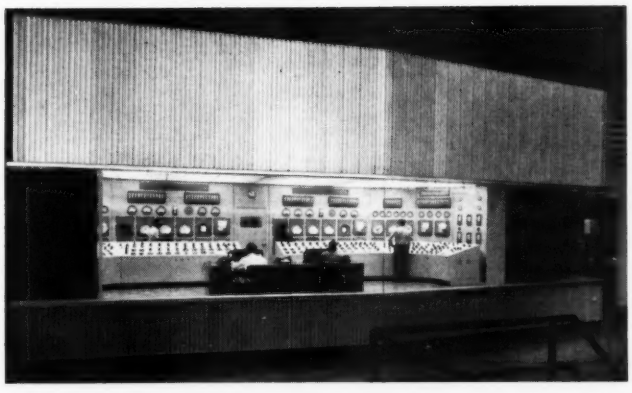


FIG. 2 — CONTROL ROOM ON THE TURBINE FLOOR FOR CONTROLLING TWO OF SHAWNEE'S GENERATING UNITS.

the unit load recorders and the automatic load control equipment are mounted on this panel.

Figs. 4 and 5 also illustrate the lighting effect obtained by a novel indirect lighting system used in the control room. Light is reflected from the arched ceiling, but it is difficult for a visitor to locate the light source. Actually, there are eighty, 150-watt, reflector-spot lamps recessed in troughs located in the tops of the instrument switchboard and the recording instrument board. These spotlight units are directed toward the ceiling, and they can be adjusted to obtain a uniform distribution of light in the control room.

This control building is one of the key operating points of the system. The automatic controls have provisions for loading the generator units at a selected rate (megawatts per minute), and for swinging the loads on any or all units up and down within a selected band (percent of full load) to maintain a constant load on a selected tie line or lines, or to maintain a constant load on some remote tie line as indicated by a telemetered load signal from the load dispatcher's office in Chattanooga.

All relays are on vertical-type switchboards in a separate room at the operator's left. This arrangement (Fig. 6) provides plenty of space for all gen-

FIG. 3 — INTERIOR VIEW OF ONE OF THE TURBINE CONTROL ROOMS AT THE SHAWNEE STEAM STATION.

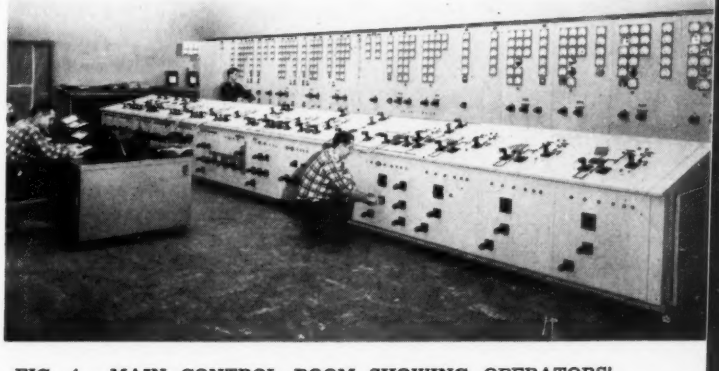


FIG. 4 — MAIN CONTROL ROOM SHOWING OPERATORS' DESKS, CONTROL BENCHBOARD, & INSTRUMENT BOARD.

FIG. 5 — PHOTOGRAPH OF THE RECORDING INSTRUMENT BOARD (LEFT) AND THE BATTERY CONTROL BOARD (AT THE END OF CONTROL ROOM.)

FIG. 6 — MAIN RELAY BOARDS IN THE SEPARATE ROOM IN CONTROL BUILDING.

erator, transformer, and line relays, and it also permits routine testing of relays without disturbing the operators. The battery control and distribution switchboards consist of vertical panels, mounted back-to-back, with the distribution panel in the relay room and the flush control panel facing into the control room (at the right of the door in Fig. 5).

All of the main control boards have wing panels in the rear to support the terminal blocks and control cables. The cables are carried through floor slots to the spreading room and then routed on trays through tunnels to the steam plant and switchyard.

Because of the importance of the load in this area, a subdispatcher's office was provided in a separate room to the right of the control room. This room (Fig. 7) has a vertical-type switchboard upon which is mounted recording instruments for total TVA generation, watts and vars from TVA to AEC, watts and vars from the Joppa plant to AEC, and watts and vars from Kentucky Utility to AEC. It also includes recorders for Shawnee total generation, the master load control signal, and recording watts and vars meters for TVA system tie lines.

### Water System Controls

All consultants know that water and coal are the raw materials for operating a steam plant, and that designing the controls for the facilities handling

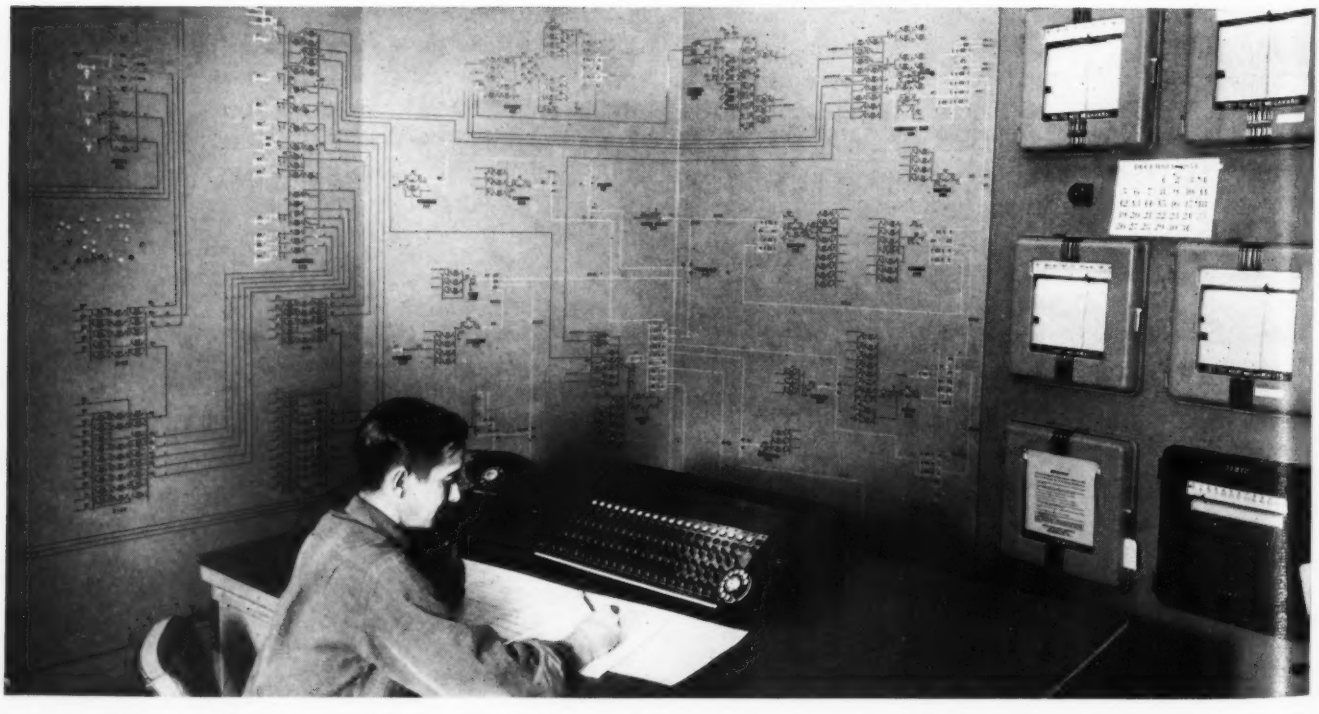


FIG. 7 — SYSTEM DIAGRAM OF SHAWNEE AREA AND LOAD RECORDERS IN LOAD DISPATCHER'S OFFICE IN THE MAIN CONTROL BUILDING SHOWING: TVA AND SHAWNEE GENERATION; WATTS AND VARS FROM SYSTEM'S STATIONS TO AEC.

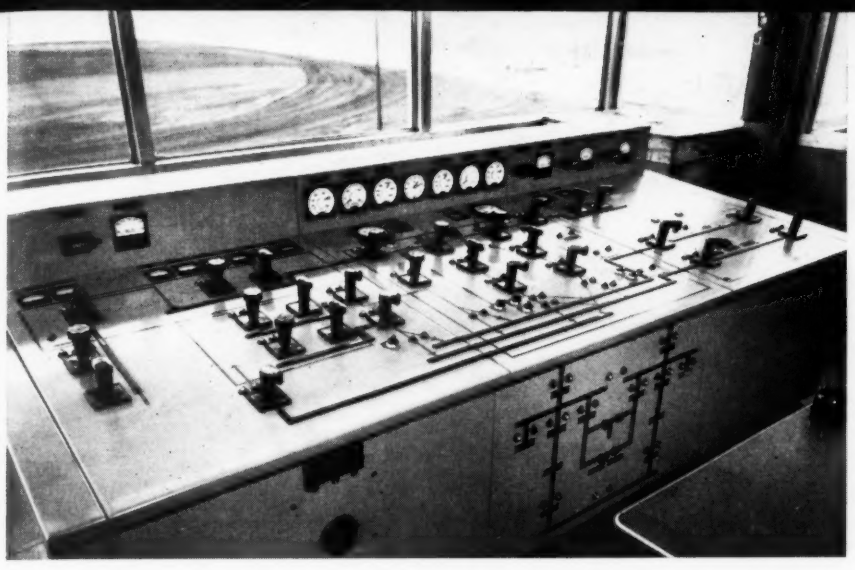


FIG. 8 — GRAPHIC CONTROL BOARD FOR CONTROLLING THE ENTIRE COAL HANDLING CONVEYOR SYSTEM AT SHAWNEE STATION WITH ONE OPERATOR.

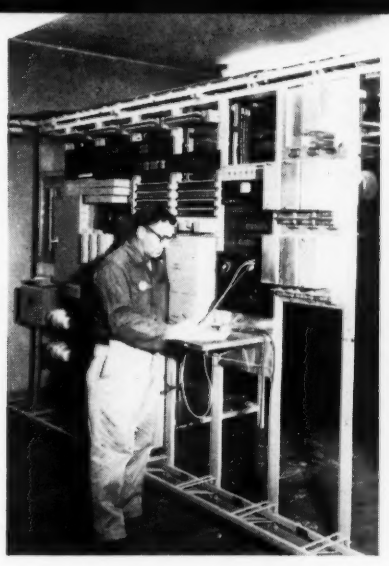


FIG. 9 — COMMUNICATIONS ROOM IN THE MAIN CONTROL BUILDING.

these materials presents interesting problems. The water intake building at Shawnee contains a standard vertical switchboard with control switches for the various valve motors. Mimic buses between switches show the arrangement of the intake piping. This switchboard has a local annunciator system and small speed indicators to show that the traveling screens are functioning satisfactorily.

### Coal System Controls

At Shawnee, all coal is delivered by barges. No facilities have been provided to receive coal by railroad. After the coal is dropped in hoppers at the barge unloaders, the entire routing is controlled by one man, operating from a control room above the crusher building. This is unique because each conveyor from the two barge unloaders is capable of handling up to 900 tons of coal per hour.

Control switches and position lamps for the various conveyors and routing chutes are mounted on a benchboard (Fig. 8) in the control room. Painted symbols indicate the conveyors from the hoppers at the two barge unloaders, the stocking-out conveyors to the coal storage yard, and the conveyors going to the bunkers in the steam plant. The benchboard has an 8-in. vertical section at the top of the sloping section, containing weight indicators to show the loading on the conveyors and Bindicators to show the height of the coal in the bins at the transfer points. In addition, a vertical switchboard, along the wall opposite the window above the benchboard, includes recorders and integrators for showing total tons of coal received from the two barge unloaders and amount of coal routed to the stocking-out coal pile.

### Communications

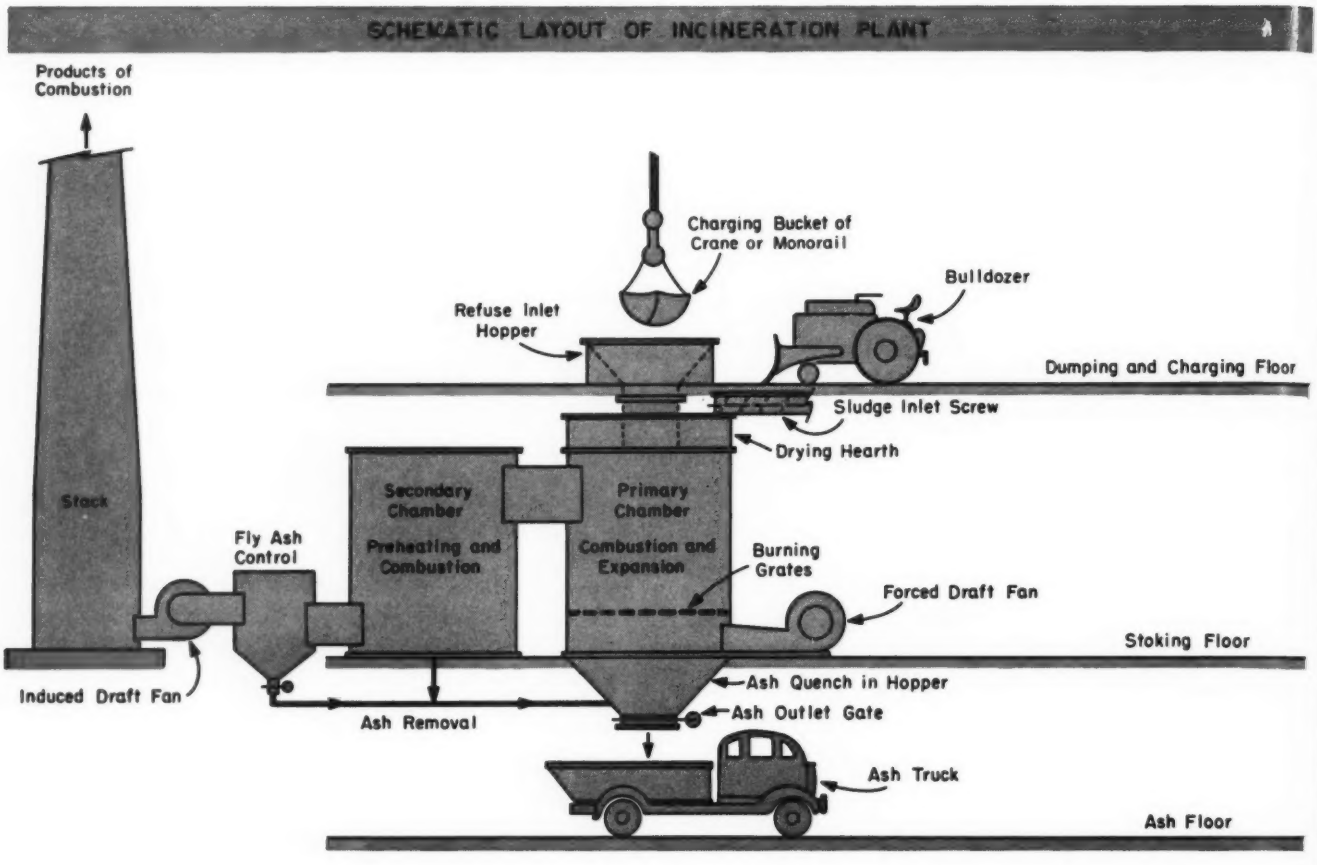
An automatic telephone system, an office intercommunication system, and a paging system with talk back facilities are provided as aids to the operators at this plant. The automatic telephone system covers the entire plant, coal handling area, control building, switchyard, and offices. It includes special features such as: a code-call system for locating persons who are not at their usual phone; conference service for a preselected group of ten telephones; and executive-right-of-way, which permits the control room operator to "break in" on a busy call in an emergency.

A key-type manual telephone switchboard on the operator's desk provides a means of connecting any local telephone to other locations on the TVA power system by power line carrier and microwave channels. Bell telephone circuits and a short-wave radio are used to communicate with the Joppa steam plant across the river. The paging system is arranged to energize loud speakers in all operating areas associated with one unit, a pair of units, or the entire plant. A turret to the left of the manual telephone switchboard has 64 illuminated annunciator windows to indicate abnormal conditions, such as hot bearings, low oil pressure, excessive temperatures, and operation of the protective relays.

### Automatic Recording Annunciator

A turret at the right of the telephone board contains the upper part of a sequential automatic recording annunciator. This equipment automatically prepares a printed record of all abnormal conditions, plus all operations of major switching equipment. Each recording of the printer includes the date and time to the nearest second. This permanent log of events is obtained automatically during emergency periods caused by trouble in the plant or major system disturbances, while the operators are busy restoring service.

Relays and test facilities for the automatic telephone system are located in a separate air conditioned room (Fig. 9) in the control building. This room also contains carrier current and microwave equipment, paging system amplifiers, and control relays for the annunciator recorder. ▲▲




# City Refuse — Burn It or Bury It

**CHARLES D. FRIDY, President**
**Fridy, Gauker, Truscott & Fridy, Inc.**

FOR MANY YEARS open dumps, with the nuisances of smoke, odors, rats, insects, and other forms of health hazards, have served as the ready and economical means of municipal refuse disposal. Today with the constant betterment of public health standards, this method can be utilized only where its remoteness from residential areas makes it tolerable.

Cp exclusive

## Disposal Methods

With the general development of fine residential districts surrounding many large cities and the concurrent reduction in availability of waste lands suitable for dumps, other means must be investigated and resorted to for the disposal of municipal refuse —rubbish, garbage, and in some localities sewage sludge cake. Under such conditions, sanitary landfill and incineration are two modern methods that are generally acceptable to health authorities, and meet with general public favor.

Sanitary landfill is accomplished by digging suitable trenches, placing all types of refuse therein, and covering with earth, thereby eliminating the nuisances created by open dumps. It provides a finished land area that is suitable for parks and playgrounds or for building sites if foundations are extended to virgin ground beneath the fill.

Incineration includes the burning of combustible refuse and firing or sterilizing of lesser noncombustible refuse at incineration plants, located convenient to the areas to be served. Modern incineration plants can reduce the refuse bulk by up to 85 percent without nuisance. Very objectionable putredinal and organic refuse, including the many dead animals collected by a municipality, is converted to inert residue well suited to low area fill without objection.

Where garbage is segregated and collected separately, other methods for disposing of this part of the refuse may warrant consideration. These include: preparation for animal feed, reduction for sal-

vage of fats and oils, and grinding and disposal with municipal sewage. Current experimentation also promises to make high-rate composting attractive.

### Project Studies

The decision as to which of these modern methods of refuse disposal is best suited to serve a community can only be made after careful investigation and study of various pertinent factors.

¶ Collection areas, frequency, and mileage.
¶ Hauling routes.
¶ Point or points of ultimate disposal.
¶ Proximity of other sources of waste.
¶ Type of refuse.
¶ Quantity of refuse.
¶ Estimated capital costs.
¶ Availability and qualifications of operators.
¶ Estimated operating costs.
¶ Restrictions.
¶ Ordinances and similar limiting factors.

It has been found that municipal mixed refuse collections generally range between 1.5 and 3.0 pounds per capita per day, varying seasonally and depending to a great extent on the current salvage value of waste paper. General refuse varies by weight from 1/3 garbage and 2/3 rubbish to 1/2 garbage and 1/2 rubbish. The moisture content of mixed refuse varies from 50 to 60 percent. Local conditions should be investigated to verify these general statistics.

Selection of the sites for disposal facilities is of great importance, particularly for a municipal installation. Many factors should be considered in site selection including: length of refuse haul; path over which trucks would pass to arrive at the site; proximity to residential areas; prevailing winds; aesthetic factors; type of terrain; stability of the soil; proximity to residue disposal area; and accessibility to power, water, and other utilities including sewage treatment plants.

When using incineration, it is deemed desirable where possible to obtain hillside sites. Then refuse trucks can enter the incineration plant from the high side. Residue can be removed from the low side, and possibly utilized as fill in still lower or ravine areas on or adjacent to the site.

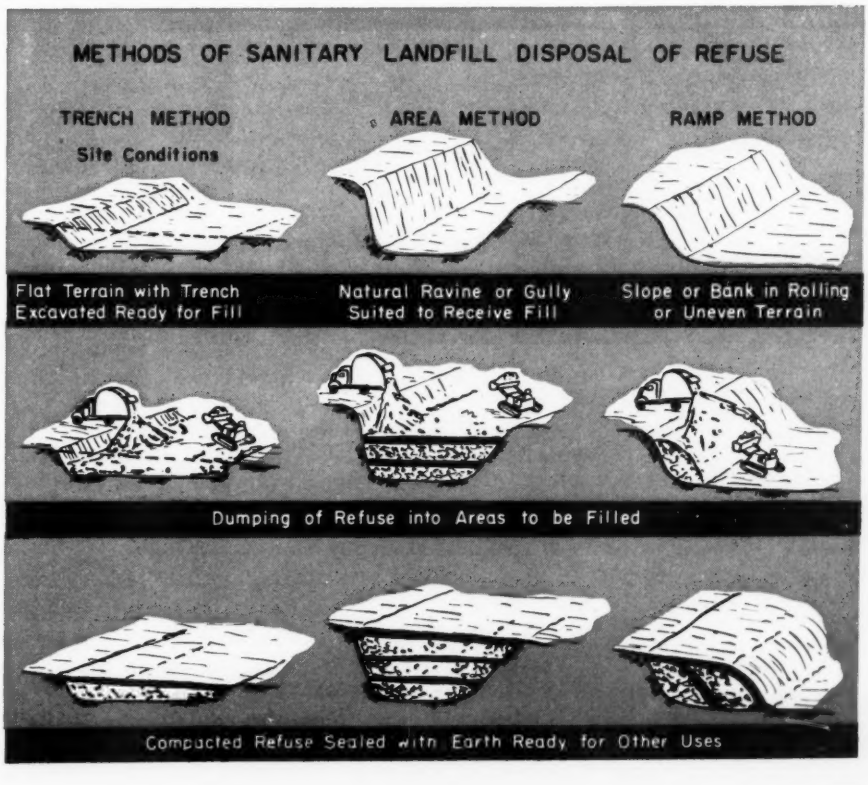
With sanitary landfill, the site well may be a submarginal or otherwise useless or swampy area, which when filled would result in an over-all betterment of the neighborhood. This area should be extensive enough to provide for approximately 5 years of continuous operation. Based on a general rule of thumb, a 6-ft depth of compacted refuse would require approximately 5 acres per 10,000 population.

The type of soil in a proposed landfill area should be investigated carefully. A soil with high clay content is subject to shrinkage cracks, and if used for cover material, would permit rodents and insects to burrow into the voids and propagate. If the sand content is high, thicker cover would be required, and moving the soil would be more difficult. Desirable soils generally consist of sand, clay, and loam with a 50 to 60-percent sand content.

### Sanitary Landfill Disposal

Where suitable land areas are available in adequate extent, a properly planned and operated sanitary landfill is a very satisfactory and economical method for disposing of all types of refuse. Frequently it permits reclaiming former waste lands for parks and recreational areas. The positive sealed-in method of properly constructed sanitary landfill also contributes greatly to public health by eliminating breeding places for mice, rats, flies, insects, and other vermin. Open burning with associated smoke and odor is not required. Sanitary landfills have been operated successfully in sub-zero temperatures and with winds as high as 30 miles per hour by digging trenches and stockpiling cover material in advance of severe cold weather.

Relatively speaking this type of disposal requires a minimum of mechanical equipment and operating personnel. In small communities, the landfill method may be only a "one-man" operation. Clearing and


METHODS OF SANITARY LANDFILL DISPOSAL OF REFUSE
TRENCH METHOD
Site Conditions
AREA METHOD
RAMP METHOD
Flat Terrain with Trench Excavated Ready for Fill
Natural Ravine or Gully Suited to Receive Fill
Slope or Bank in Rolling or Uneven Terrain
Dumping of Refuse into Areas to be Filled
Compacted Refuse Sealed with Earth Ready for Other Uses

trenching the selected area, spreading the refuse in the trench, compacting and covering with earth can be performed with a single piece of equipment and one operator. In larger communities or cities several units provide an economical disposal method.

### Constructing Landfills

Three methods—trench, area, and ramp—as indicated in the accompanying sketches, commonly are employed to construct sanitary landfills.

*Trench Method.* Initially, a trench approximately 3-ft deep, 15 to 25-ft wide, and from 75 to 400-ft long is prepared, with the excavated material being used to form a ramp along one side of the trench. Trucks dump from this ramp, and the refuse then is brought together and compacted into a cell by a crawler type tractor. Successive layers of refuse are placed and compacted until the day's refuse has been formed in the trench. The cell is completed by placing and packing a 2-ft thick earth cover over the exposed surface. The open end of the cell also is sealed with a 1-ft wall of earth at the end of each day's operation. Soil removed in excavating the subsequent trench area generally is the cover material.

*Area Method.* Where relatively deep ravines or gulleys exist, the refuse can be dumped directly into these natural depressions, compacted by passing tractors, and covered with earth borrowed from adjacent hillsides. Refuse is deposited and compacted, usually in layers ranging from 6 to 10-ft deep, and then covered with earth approximately 2-ft thick. Each day's deposit is covered, and as the work proceeds care is taken to avoid disrupting the natural drainage. This procedure is continued until the landfill is brought to final desired grade or elevation.

*Ramp Method.* In rolling or uneven terrain a slope or bank is selected as a starting point, or an artificial ramp can be constructed. Refuse is dumped at the bottom of the slope or ramp and the material bulldozed and compacted against the sloped section of the ramp in layers. Placing and compacting operations continue throughout the day, while additional truckloads of refuse are dumped. In this continuous cut and cover process the completed row contains a number of compacted and sealed cells of refuse, and the next row is ready for filling.

Adequate and suitable equipment is essential to any of these sanitary landfill operations. The type and characteristics of the equipment will be dependent upon the size of the community, terrain at

### SUGGESTED SCHEDULE OF PROCEDURES FOR MUNICIPAL REFUSE DISPOSAL PROJECTS...

Coverage of Preliminary Engineering Report

1. Zoning of municipality into disposal districts.
2. Disposal site selection for each district or group of districts.
   a. Minimum, maximum, and average collection mileage.
   b. Frequency of collections.
   c. Possible hauling routes in residential, commercial, and industrial areas.
   d. Prevailing winds.
   e. Type of terrain.
   f. Suitability of soil.
   g. Proximity to source of sewage sludge cake.
   h. Accessibility of other utility services.
   i. Availability of operating personnel for the plant.
   j. Point or points of disposal of ashes, residue, and noncombustible materials.
   k. Type and number of collection trucks.
3. Types and quantities of waste.
   a. Garbage (% moisture).
   b. Rubbish (combustible) — moisture variations.
   c. Rubbish (noncombustible).
   d. Sewage sludge.
   e. Collection procedures — separate; combined.
4. Local restrictions in the area.
   a. Zoning
   b. C.A.A.
   c. Smoke and fly ash abatement ordinances.
   d. Art Board
5. Recovery possibilities.
   a. Salvage — method and economies for waste paper; cans; other types of noncombustible materials.
   b. Waste heat — steam; electric power.
6. Sanitary landfill.
   a. Suitability and economic considerations.
   b. Most favorable method — trench; area; ramp.
   c. Equipment
   d. Conclusions
7. Type of incinerator.
   a. Operation — hours of collection; hours of operation.
   b. Receiving—bin with crane or monorail; floor dump and bulldoze.
   c. Charging — open gate with manual charge; hopper and mechanical gate.
   d. Multiple furnaces — flexibility of operation for seasonal variations in loading; moisture content variations and control; future growth in collection district.
   e. Method of stoking — manual; mechanical.
   f. Combustion chambers — waste heat recovery; sprays for cooling of hot gases; fly ash arrestors; FD and ID fans.
   g. Stack — high temperature (lined, corsetted, and target wall); low temperature (steel, brick lined).
8. Residue.
   a. Quenching.
   b. Discharge and trucking.
   c. Segregation of salvagable materials — conveying; crushing; bailing; possible outlets and their locations.
9. Building.
   a. Architectural treatment.
   b. Type of construction.
   c. Appurtenances — truck weigh scale; garage for trucks with repair shop for maintenance; office and personnel facilities.
10. Preliminary Drawings.
    a. Plans; elevations; sections.
    b. Rendered Perspective.

the site, size and number of operations, and other local factors. Generally one crawler-tractor with high front end loader will successfully operate each landfill for communities of 50,000 population or less.

For populations exceeding 50,000 the number of units required logically will depend on local operating conditions. At small communities particularly, the equipment would be utilized for this service only part time, permitting other operations such as: snow plowing, truck loading, road maintenance or construction work, and similar municipal jobs, during off-demand periods at the landfill. However, precautions should be taken against equipment outage for any extended period.

### Incineration

Mechanically stoked furnaces lend themselves very readily to the incineration of mixed municipal refuse—not only garbage and combustible rubbish but also raw or digested sewage sludge. This characteristic is important because with the increase in the number of municipal sewage treatment plants and the higher degree of treatment they provide, finding a suitable market or ready outlet for sewage sludge will become increasingly difficult. Applying the principle of the multihearth, incinerating furnaces to the modern mechanically stoked refuse incinerator, provides a sanitary, practical solution to municipal waste and sludge disposal problems.

Designs for incineration plants for the destruction of all waste from metropolitan areas, as shown on the schematic layout sketch, illustrate this arrangement. Garbage and refuse is incinerated in mechanically stoked furnaces. Raw sewage cake, from the adjacent sewage plant, (after being dewatered on vacuum filters to 70-percent moisture) is dried on an upper rotary hearth by the heat of combustion from the main hearth of each furnace. When properly dried, the sludge is discharged automatically onto the lower or main hearth for incineration with the garbage and rubbish. Thus, this process provides heat recovery while disposing of an otherwise noxious waste, although its application requires favorable project conditions.

### Design Factors

In designing an incineration plant, various factors must be studied.

*Plant Capacity.* Incineration capacity requirements vary considerably depending on the type of refuse to be burned, the rate and frequency of collections, the range of moisture content of the refuse, and the duration of the burning period or operating day. Most plants are rated in terms of their incineration ability on a 24-hr day basis, with correspondingly less capacity for 8 or 16-hr operations. However, if the plant can be operated on a 24-hr daily schedule, many automatic control features that are not warranted economically on a one or two shift operating basis would be worthy of consideration and use. Project conditions again are the governing factor.

*Receiving Refuse.* In municipal installations, rated at 100 tons per day and above, consideration should be given to the use of a receiving bin with crane type of refuse handling system. With this layout all refuse to be incinerated is dumped directly from collection trucks or trailers into a large armored concrete receiving bin without the use of long, costly ramps. Refuse can be segregated readily in the bin, permitting the storage of a nominal quantity of dry, readily combustible material to serve as

## USING INCINERATION PLANTS OR SANITARY LANDFILLS

### Selection of Furnace Equipment and Appurtenances

1. Recommendations of consulting engineer's preliminary report, embracing:
   a. Site selection.
   b. Materials to be incinerated.
   c. Hours of operation.
   d. Environmental conditions.
   e. Capital costs.
   f. Operation costs.
   g. Maintenance.
   h. Operational record.
   i. Smoke and fly ash control.
   j. Recommended furnaces and appurtenances to be incorporated in final plans and specifications.
   k. General supervision of construction by consultant.
2. Competitive bids by furnace manufacturers, based on:
   a. Site limitations.
   b. Governmental and municipal requirements — smoke and fly ash control; building codes; zoning requirements; Art Board; C.A.A.
   c. Capacity — period of incineration.
   d. Environmental conditions.
   e. Capital costs.
   f. Operating costs.
   g. Maintenance statistics.
   h. Operational record.
   i. Smoke and fly ash control guarantee.
   j. Warranties; guarantees.
   k. Engineering evaluation of bids; recommendations.
   l. Award of equipment contracts by municipality including: installation, initial operation, instructions, and guarantees, to manufacturers directly.
   m. General supervision of construction by consultant.

### Construction of Building and Appurtenances

1. Architectural, structural, and mechanical drawings and specifications for construction bidding on the project.
2. Awards for construction of general, plumbing, heating, and electrical contracts by municipality to respective successful bidders in each trade.
3. General supervision of complete construction of project by the consulting engineer.

kindling and supplemental fuel on days of wet collection. A bin also permits operation of the furnaces at times other than the actual hours of delivery of refuse to the site, thereby fully engaging the time of operating personnel. Smaller units can be used at a constant or uniform rate of charging, over part-day or 24-hr periods with this arrangement.

Where economically possible, it has been found desirable to provide an enclosed entrance at the receiving bin for dust control. This feature can be combined with the conventional weighhouse and truck scale used to provide accurate control and records of the refuse handled.

Site limitations and plant design naturally will influence the arrangement of the bin. Layouts where a rectangular receiving bin is located with its short side adjacent the furnace building and its long axis on the center line of the multiple furnace hoppers utilize a short span, limited transverse type of crane. With equal flexibility, the bin can be placed with long side adjacent the furnace building by utilizing a long span, wide transverse type of crane.

*Crane.* Traveling cranes with 1½ to 3-cu yd buckets are suitable for hoisting selected refuse from the receiving bin and depositing it in the furnace charging hoppers—generally located on the uppermost or charging floor of the incinerator building. This crane also can be utilized to advantage to sort the refuse in the bin; to reject objectionable material, such as bed springs, boilers, and other large metallic articles; and to remove excessively wet material and reload it on trucks for dump disposal. Small plants may operate without a crane by dumping the refuse directly on the charging floor and manually feeding or bulldozing it into the charging gates of the furnaces.

*Stoking.* While most small, and many of the earlier large, incineration plant designs were predicated on manual stoking, current practice consistently favors the more efficient and economical mechanically stoked method. This arrangement achieves a more uniform and complete combustion of the refuse, thereby helping greatly in maintaining smoke and fly ash discharges to the practical and acceptable minimum. Labor requirements are nominal. Modern instrumentation and electronic devices provide precise, automatic control. Optimum operation, impossible only a few years ago, now can be maintained.

*Burning and Combustion.* In general the collection of tin cans with either the garbage or rubbish is considered favorable. Cans are handled readily by mechanically stoked furnaces, and they assist combustion by providing voids in the refuse on the burning hearth that facilitate the flow of preheated forced draft air. With modern dumping hearths and quenching devices the noncombustibles, along with other consumed ash products of combustion, are delivered in a thoroughly clean and sterile condition to the residue recovery equipment or dump. Such material placed on a noncombustible dump area will not attract vermin. Under favorable market conditions, it has worthwhile salvage value when crushed and baled as scrap metal.

At some installations it is economically feasible to include a waste heat boiler in the plant design to recover the heat from the incinerator gases of combustion. Steam derived from waste heat boilers has many practical uses. It can be used for heating the incineration plant and adjacent buildings, or for producing electric power. The economic aspects obviously will depend on the size of the installation and the operating cycle. Unfortunately, very few projects can utilize this arrangement.

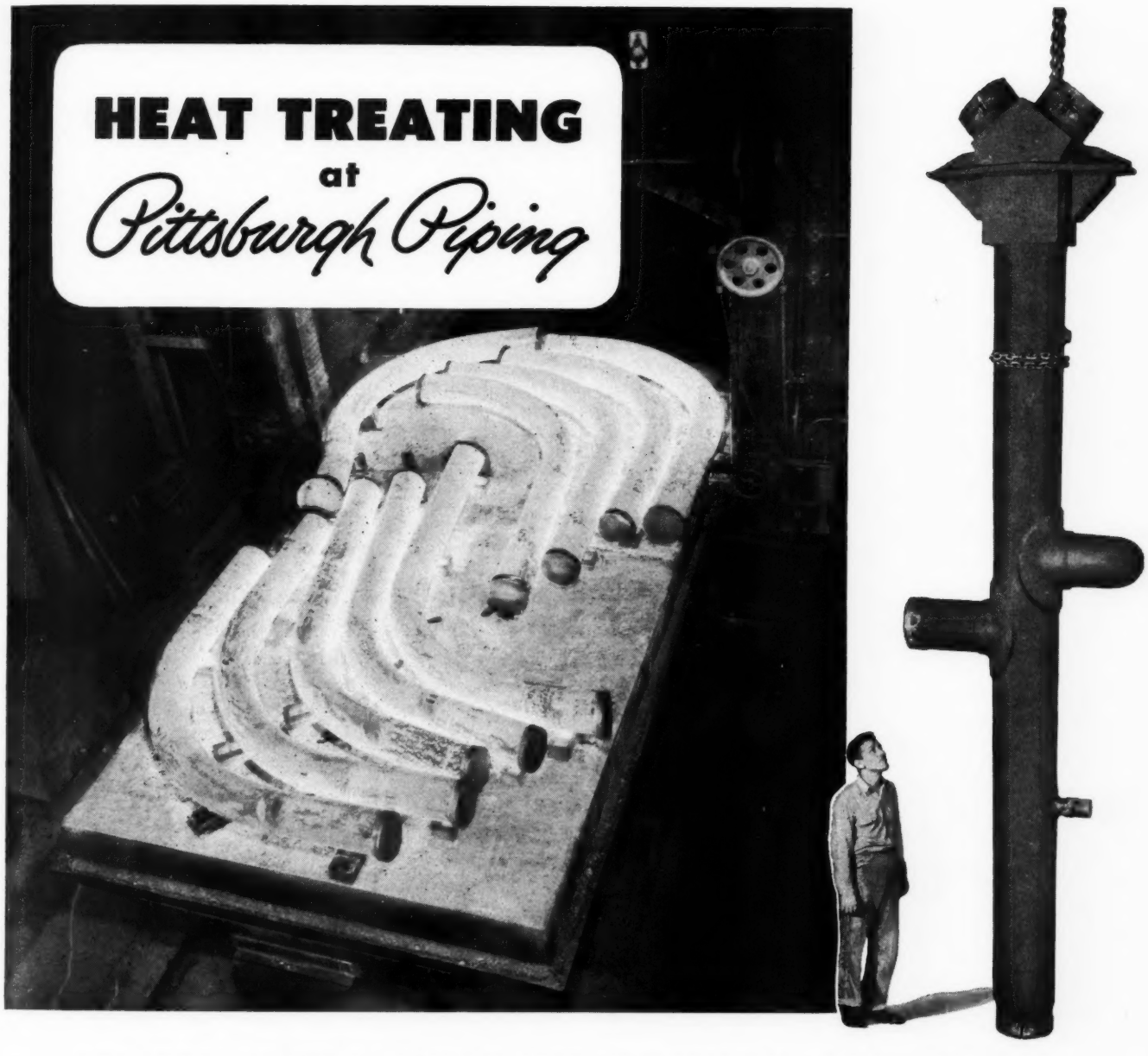
*Temperatures.* It is considered desirable to maintain furnace temperatures between 1400 and 1800 F to protect the refractory linings and castings. This requires proper selection of suitable refuse materials from the bin and control of the draft air temperatures to compensate for the moisture condition of the refuse being incinerated. The use of preheaters depends on the type of refuse, but in general they are desirable with high moisture content refuse.

*Chimney.* Incinerator chimneys should be high, should have adequate capacity, and should be lined as required to withstand gas temperatures discharged from the furnaces and combustion chambers. The size will vary, dependent on the type of furnace and whether induced draft and ash-arrestor equipment is utilized.

*Fly Ash.* Many municipalities have regulations stipulating limits on the amount of smoke and fly ash from incinerator stacks. Keeping fly ash to a minimum is particularly important in residential areas, and much progress has been made in solving air pollution problems.

Modern plants, including specially designed combustion chambers and arrestor equipment, now cool the gases, spray them, collect solids on impinging plates and provide means of sluicing to catch the residue. With such arrangements incineration plants can operate within statutory requirements without an unreasonable increase in cost. At lower gas temperatures some of the increased cost can be compensated for in the chimney design. However, recent trends indicate the desirability of having the chimney capable of operating at both high and low temperatures. This permits the installation of a by-pass around the arrestor equipment and provides greater operating flexibility.

*Visual and Aesthetic Aspects.* Modern architectural treatment of the building structure and attractively landscaped surroundings make today's municipal incineration plant vastly different from its prototype of a few years ago. Served by fully enclosed, "compactor" type of collection trucks, current well managed incinerators compare favorably with modern industrial manufacturing plants. Good appearance and working conditions are recognized as an asset to the community. ▲▲

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Heat treating and stress relieving at Pittsburgh Piping are operations which produce a uniform grain structure, assure consistent mechanical properties, and remove residual stresses throughout the length of each fabricated piping assembly.

P.P.&E.'s modern gas-fired furnace, illustrated above, is a specially-developed design. Time-temperature conditions can be electronically controlled in it for proper heat treatment of each type of metal.

This heat treating procedure is assurance that piping fabricated by P.P.&E. will have the most desirable combination of ductility, toughness, impact resistance, and strength.

**PRODUCTS AND SERVICES**

Carbon Steel Piping
Cast Iron Fittings
Cast Steel Fittings
Chrome-Moly Piping
Copper Piping
Corrugated Piping
Creased Bends
Expansion Bends
Flanges
Forged Piping Materials
Headers
Manifolds
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PP-13

# Notes FROM ABROAD

### Austria

To help create a basis for an international standard for the use of aluminum as an electrical conductor, the research and testing laboratories of the "Ranshofener Werke" in Austria have been studying the relationships between the electrical and mechanical properties of this material for various quantities and types of constituents (primarily Si and Fe), the metallurgical structure, and the degree of cold-working.

The excellent properties of aluminum as a conductor (high conductivity — both electrical and thermal, low specific weight, and good mechanical properties) are not quite reached by the aluminum alloys (AlMgSi — known commercially as "Elran" or "Aldrey") that are used in practice. However, the equivalent weights of conductors having the same conductivity and tensile strength are lower for aluminum than they are for copper.

Some of the interesting points cited in this report: If a short circuit occurs, the temperature rise of an aluminum conductor is considerably less than for copper and a correspondingly smaller decrease in the strength of the hard-drawn aluminum wire takes place. The safety against arcing is better with aluminum because the smaller rise in temperature reduces the chance of the wire reaching its melting point. On the other hand, if the conductor does melt, the aluminum oxide formed is a non-conductor and will help cause the arc to break down.

These, and the economic advantages of aluminum over copper — inexhaustible reserves of raw material, easy to cast and process, cheap to transport and erect because of its low weight — are furthering interest in the study of aluminum as a conductor.

### Airport Runways

A process has been developed by Austrian engineers for the use of prestressed concrete on an airport runway which practically eliminates joints and considerably increases the carrying capacity of the strip.

The new method was adopted for a 200 meter extension of the east runway of the Vienna-Schwecht airport. This extension is exposed to the greatest wear and stress since the airplanes take off and land on this end against the main direction of the wind.

The runway extension consists of two prestressed concrete slabs of 6000 sq meters each. As compared with the old type of construction, the number of joints has been reduced by 96.7 percent. The concrete was prestressed by inserting wires into a 20 cm (about 8 in.) thick layer. This prestressing increased the carrying capacity of the runway to equal that of an ordinary concrete surface 30-35 cm (12 to 14

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in. roughly) thick. There is no risk of fracture of the prestressed surface even under high stresses.

### Germany

An all-metal seamless tubing that is suitable for the transmission of steam and high pressure hot water, gases, compressed air, and other non-corrosive liquids was recently announced by a West German manufacturer. With diameters from ½ in. to 4 in., maximum pressures up to 400 psig, and bending radii from 4 in. to 20 in., the tubing features inherent strength with unusual flexibility. For higher pressures, double wall tubing and steel braid reinforcements are available.

### Great Britain

The English manufacturer, W.S. Barron and Son Ltd. (who hold manufacturing rights in the U.K. and Europe), points out that screw lifts deserve to be better known because of their efficiency, versatility, and dependable operation in handling bulk materials.

Lifts may be fed by gravity in the case of granular materials such as cereals and nuts, or by horizontal screw conveyors for soft stocks such as flour and sugar. Lifts are largely self-cleaning and this makes it easy to use them for different materials in succession, given a short clearing period between.

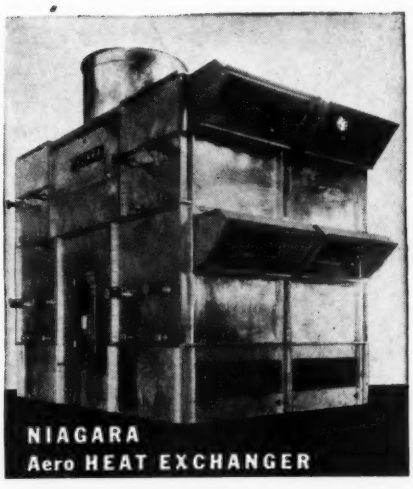
Screw lifts are available in diameters of four, six, nine, and twelve inches with respective capacities of 75, 300, 1000, and 2500 cu ft per hr; in the case of flour, the last mentioned rating corresponds to 45 tons per hr. For installation, they require only a very small area, the machine of largest diameter requiring only a 20-in. hole through the floor. Also, since they are of sectional construction, it is easy to assemble them and to add or remove sections as requirements demand.

### Windmill Generator

British engineers are enthusiastic over results of tests conducted on a 100 kw windmill erected on the 400 ft high Costa Head on the mainland of Orkney, one of the Orkney Islands north of Scotland. The idea behind the windmill was to design a machine that could generate electricity in suitable and reliable quantities for areas where coal was scarce. Britain's North of Scotland Hydro-Electric Board commissioned the Scottish firm of John Brown & Co., Ltd. to design and construct this pilot generator as a prototype of a proposed 250 kw windmill.

The windmill consists of a 78 ft steel tower on which is mounted the generator nacelle, gearbox, and rotor arms. Swept diameter of the blades is 50 ft, and at winds of 35 mph or above they rotate at sufficient speed to generate full power.

Blades are of compressed laminated wood with high tensile steel fittings. Each blade is attached at its root to the end of the hub arm by hinged joints which allow it to lean forward or "cone" with the wind forces and to lean in the direction of rotating or "drag" due to turning efforts set up in driving the generator. A small "pilot" windmill mounted on top of the nacelle turns at a speed proportional to wind velocity and signals the main control gear when to start or stop the windmill. The next step will be construction of the 250 kw unit, with the hope that eventually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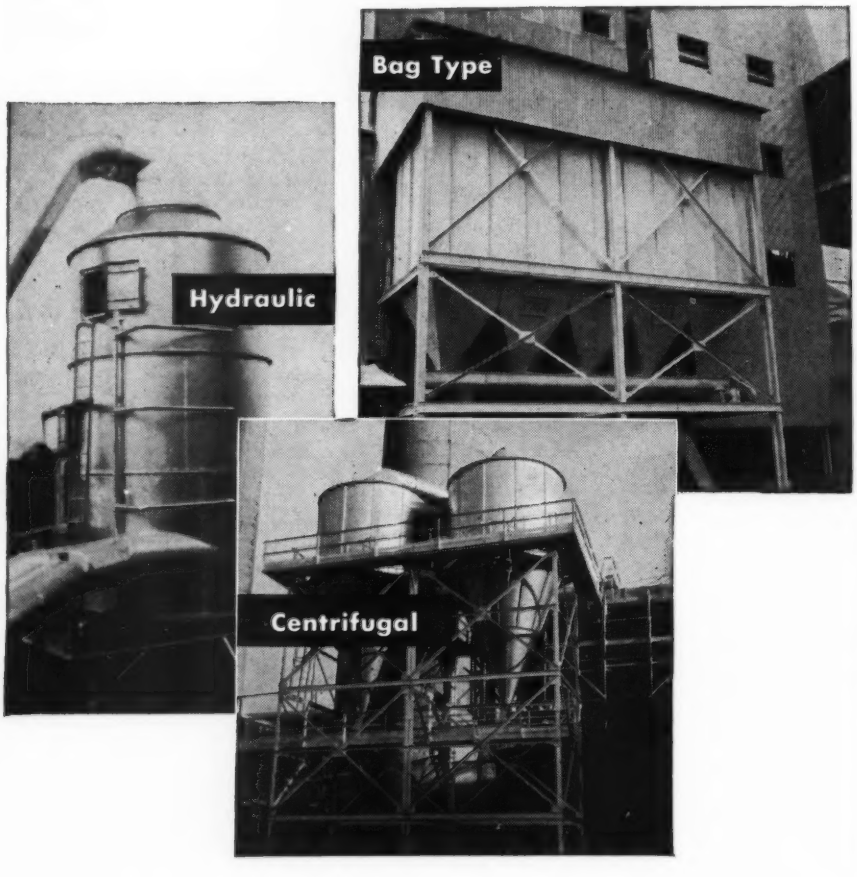


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even larger windmill generators will be practical.

### International

At the present time some 31 American universities are taking part in technical cooperation programs in 22 foreign countries through contracts financed by the Foreign Operations Administration (FOA functions were taken over by the International Cooperation Administration July 1). Many of the contracts are with universities in the host countries; some call for work with the host government. Contracts cover U.S. assistance in setting up agricultural development projects, training engineering, education, and business administration teachers, and economic and social development work.

Typical contracts for engineering cooperation are:

Armour Research Institute — ($195,000) to work with the Industrial Development Corp., Ministry of Industry and Mines, of the government of Burma in the field of industrial research and development — ($90,000) to do similar work with the Mexican Institute of Technological Research, Bank of Mexico.

Cornell University — ($100,000) for assistance to Burma's Ministry of National Planning in the use of aerial photography in economic development.

University of Illinois — ($450,000) to expand the engineering program at India's Institute of Technology.

Purdue University — ($250,000) to expand the Taiwan (Formosa) College of Engineering.

Texas Agricultural and Mechanical College — ($1,700,000) to assist the University of Dacca in East Pakistan in reorganizing its courses, teaching methods, and administration in agriculture, engineering, and other fields.

### "Atoms For Peace" Conference

The big name in the headline news in Europe these days is Ge-

neva . . . . not only because of the Big Four "summit" meeting in July but the Atoms For Peace Conference and Exhibition that will follow shortly after (August 8th through 20th).

The American AEC's full-scale nuclear reactor that is being shipped over has been amply publicized. But the "dark horse" of the three countries with major exhibits — U.S., Great Britain, and France — will be Great Britain. The British have rented the largest amount of floor space, 2750 sq meters (compared with 2250 sq meters for the U.S.). Aside from the British Atomic Energy Commission, over 100 private British firms are expected to be represented. It's no secret that they hope to walk off with a few million dollars worth of orders for furnishing all the materials for the construction of complete nuclear power plants.

Of the 150-odd British firms working in the field of nuclear energy, four separate combined-organizations have appeared that are prepared to offer a complete "package" atomic power plant. The first group is made up of the Associated Electrical Industries Ltd., Metropolitan Vickers, British Thomson Houston, and John Thompson. The second group combines the General Electric Co. with the Simon-Carves boiler firm. The third group is the English Electric Co. and Babcock-Wilcox. And the fourth group, made up of the following, C. A. Parsons, Head Wrightson, and A. E. Reyrolle, call themselves the Nuclear Power Plant Co.

The Atomic Conference and Exhibition will give the general public its first opportunity to measure the international progress in the development of peaceful applications of atomic energy as shown by the products of the different manufacturers. All indications are that the events in Geneva are another step in making nuclear energy a commercial reality in the near future. ▲▲




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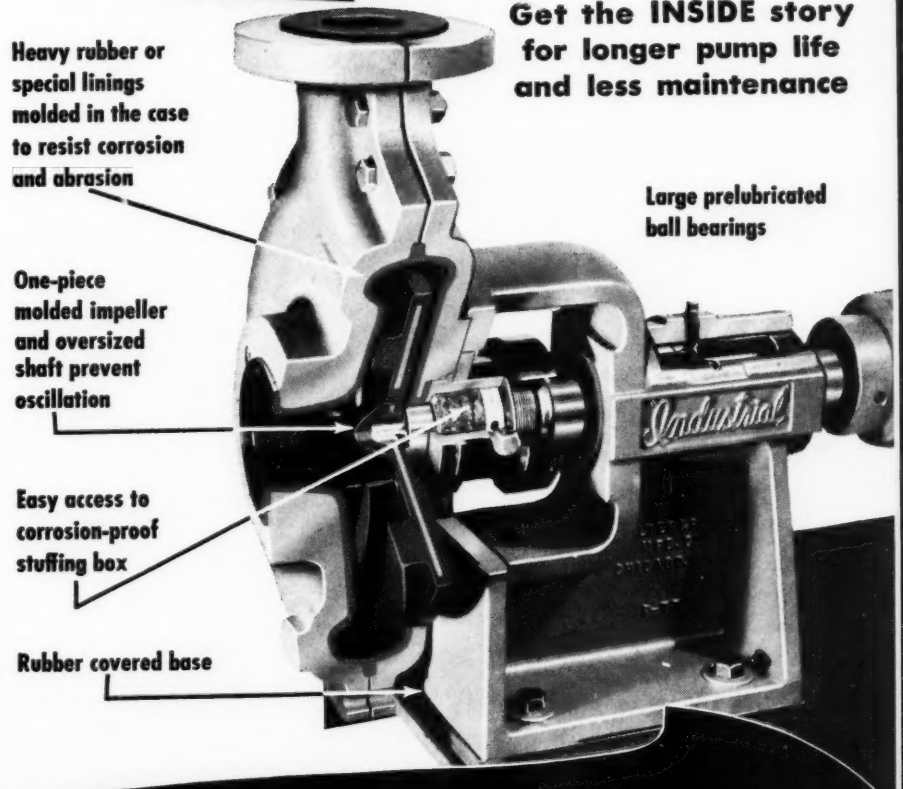
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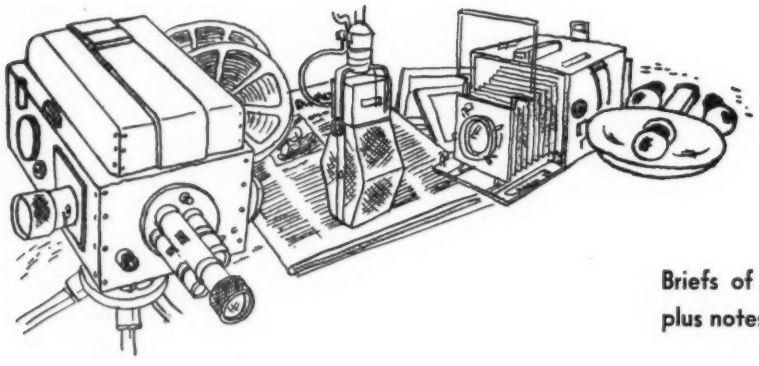


# NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering

## Consulting Engineers Plan National Convention for October

In 1954 there was discussion among state consulting engineering associations then being formed concerning a national convention or a national meeting to discuss mutual problems and possibly formation of a national organization. The Consulting Engineers Association of Oklahoma and the newly formed Missouri Association of Consulting Engineers announced plans this month for such a meeting. The date has been set for October 28-29, in St. Louis, Mo.

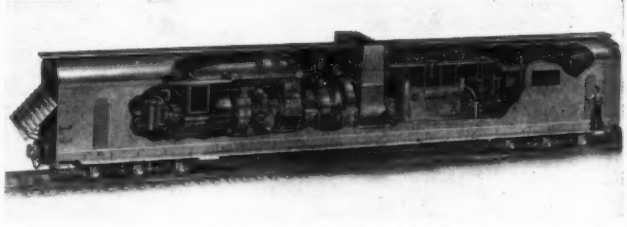
C. C. Pate, secretary-treasurer of the Oklahoma Association, outlined the following aims for the meeting, "It is our thought that the various groups should not form a tight national organization but rather be an association of the various state or city groups. Under this procedure, the individuals would not become members of the over-all organization but the state organizations would be members. This leaves the direction and policy making in the hands of the individual groups, and the national organization, through correspondence and conventions, would be a meeting ground for the exchange of ideas rather than the establishment of definite policies. Most consulting engineers are individualists and chafe considerably under iron clad regulations emanating from a national organization. We realize that each state and region has separate problems that affect the other associations only minutely and cannot be established as definite policies."

Further information and reservations are available from Mr. C. C. Pate, Consulting Engineers Association of Oklahoma, P. O. Box 4186, Tulsa, Okla.

## Gas Turbine Power Plant Mounted on Railroad Car

A self-contained mobile power station — a gas turbine driving a 5500 kw generator — mounted on a single railroad car was introduced last month by Clark Bros. Co., at Olean, N.Y. The plant, designed for the U.S. Navy, can be used as a source of emergency power in the event of a disaster, or as a prime source wherever normal means of power generation are not feasible for economical or physical reasons. The car is designed for standard gage track and may be moved at speeds up to 60 mph. Once at the site, only electrical load and fuel supply connections are needed. The plant can be operating within a few hours after arrival.

The gas turbine consists of an axial flow compressor and axial flow turbine with two shafts. The first turbine, with two stages, drives the axial flow compressor supplying combustion air. The second turbine runs independently and drives the load generator directly at 3600 rpm. Facilities are provided in the fuel system for operation of the gas turbine with residual fuel oils. With this type of fuel it is



FROM L. TO R. ARE DIESEL ENGINE, GAS TURBINE, GENERATOR, EXCITER, FUEL PUMPS, CONTROL ROOM.

necessary to limit the turbine inlet temperature to 1150 F. Expected maximum output at this temperature is 3200 kw. The turbine is designed for normal operation with No. 2 diesel oil at an inlet temperature of 1350 F.

Only one trained operator is required to start and operate the plant. At startup the auxiliary diesel engine is used to bring the turbine up to sustaining speed. This unit also provides all of the power for the electric auxiliaries. When all requirements for starting are met, a ready-to-start lamp signals the operator to push the start button. This initiates a series of automatic operations. When sustaining speed is reached on the turbine, the starting engine automatically disengages and after turbine warm up, the main generator speed is adjusted to synchronize with the auxiliary generator which is then shut down. The main circuit breaker is closed and the turbine control switched to automatic.

Dual metering and/or suitable transfer switches are used to make the apparatus suitable for operation at either 50 or 60 cycles. Synchronizing lamps

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### Gas Turbine Power Plant

—*Starts on page 64*

make it possible to parallel the main generator with outside power source.

None of the switchgear or control apparatus need be dismantled and stowed while the power plant is in transit, and for normal maintenance, roof sections of the railroad car are opened over the work area.

Westinghouse Electric Corp. has also developed a mobile, gas turbine power plant — to be used by the U. S. Army to support military operations in the field or in other emergencies where conventional power sources are damaged, inadequate, or non-existent. This 5000 kw plant is contained in two, 54-ft long railroad cars: the first car carries the 5700 rpm gas turbine and two-speed generator; the second car contains switchgear, electrical controls, and a transformer capable of putting out 2500 to 15,000 v. The cars are adapted for standard American gage and also for 60, 63, and 66 in. for foreign railways.

### Print Reproduction Method Cuts Tracing Time 95 Percent

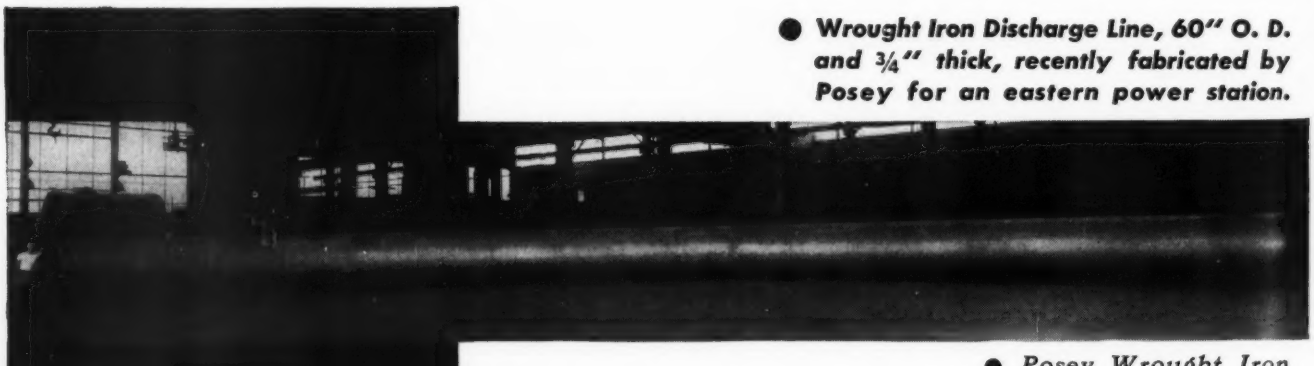
New techniques in the use of photo-mechanical materials and processes have reduced by 95 percent the time needed to produce engineering drawings in the Medium Voltage Switchgear Dept. of General Electric Co. The department annually supplies thousands of copies of drawings of equipment shipped to purchasers. Formerly, each of the drawings or tracings required 6 to 18 hours to complete by conventional means.

The new system, developed by L. G. Frenkau, supervisor of the blueprint section and A. F. Piscone, supervisor of drafting practice, utilizes the time of a clerk rather than a draftsman or engineer.

The engineer or draftsman prepares a simple coded order for the blueprint section. This order gives all necessary instructions for the preparation by a clerk of a composite positive film transparency, comprising reusable positive film overlays, from which a translucent auto-positive is printed by conventional photo-mechanical methods. The autopositive, which thus becomes the original tracing, is tougher than conventional tracing paper and can stand rough handling. It has sharper contrast with dense, crisp, black lines which permit high printing speeds. Erasures can be made by moistening the image and using a soft eraser.

Several other departments of the General Electric Company are now studying the system with a view to adopting it to their operations.

Another development that promises to reduce drafting time and cost is a new manufacturing process for Frederick Post Company's PTM tracing medium that gives the paper the printing quality of

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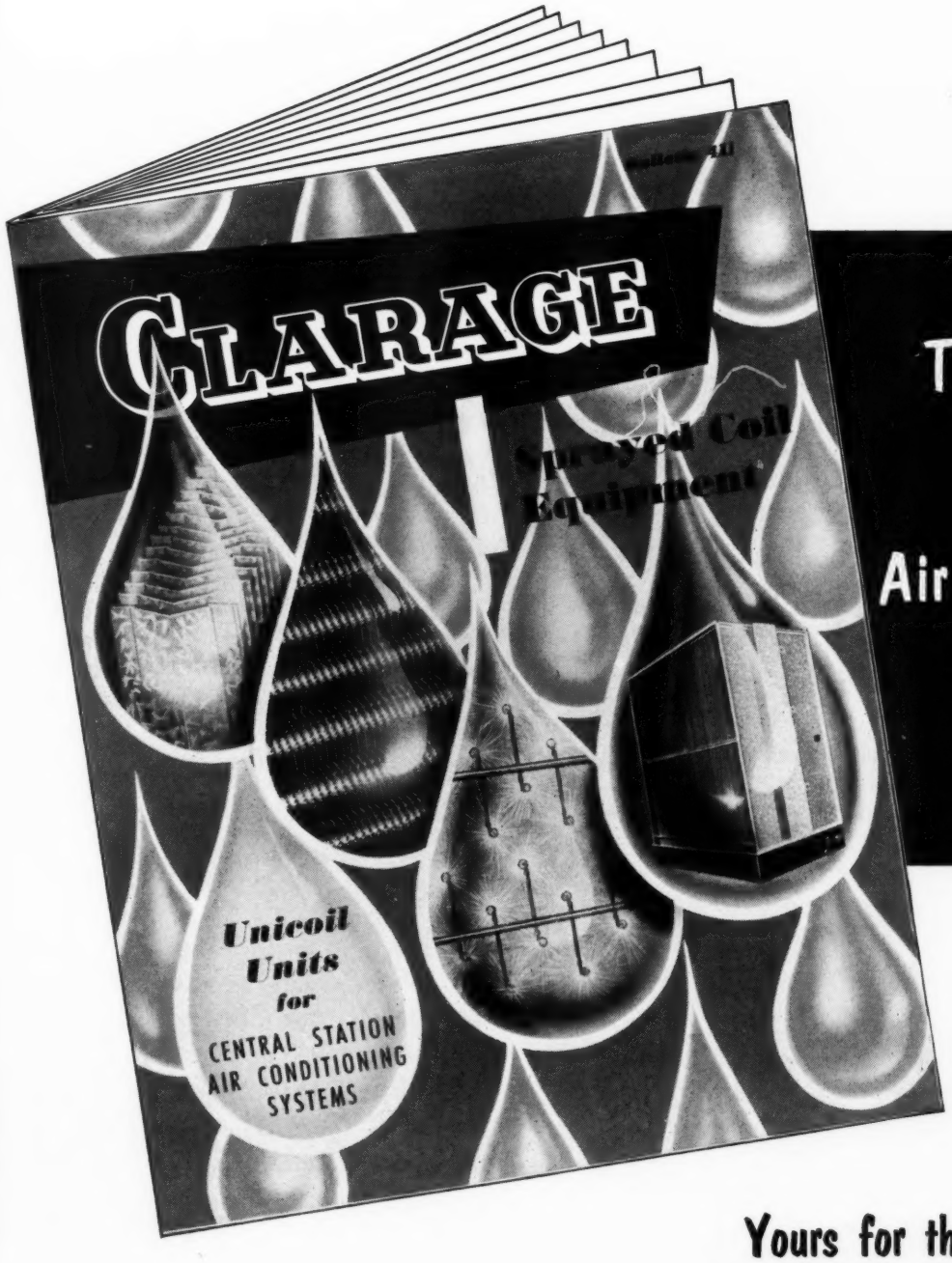


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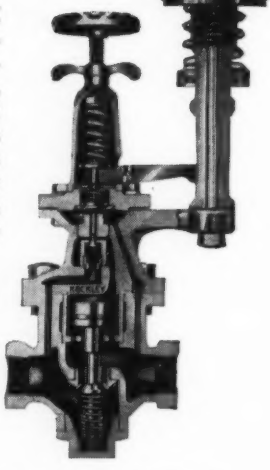

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### Print Reproduction Method

—*Starts on page 66*

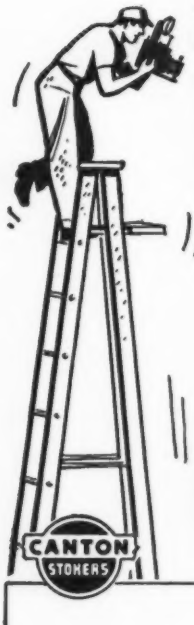
film. The process, known as welding, is said to produce a film-like transparency, an evenly textured surface with uniform drafting qualities in every direction, and dimensional stability.

### Cooling Tower Standards Available

After five years of research and field testing on industrial cooling towers, the Cooling Tower Institute has prepared three bulletins of standards. All elements of the CTI specifications are compatible with the present drafts of technical society codes covering such equipment.

The three bulletins are: ATP-105, "CTI Acceptance Test Procedure," (50¢ each) which gives a basic procedure for testing cooling ability of any industrial tower; STD-101, "CTI Grades of Redwood Lumber," (25¢ each) containing recomendations for use of special grades; and STD-102, "Structural Design Data," (25¢ each) in which design stress allowables are described for CTI Grades of lumber.

Bulletins are available from the Cooling Tower Institute, 444 Emerson St., Palo Alto, Calif. ▲▲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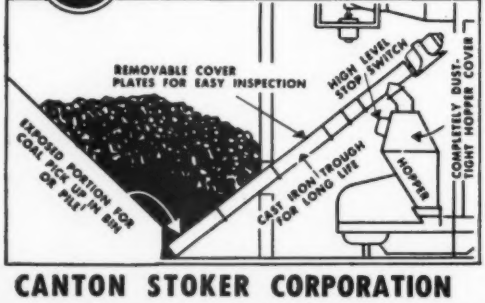
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# AFTER-COOLER FOR NEW DETROIT FOUNDRY

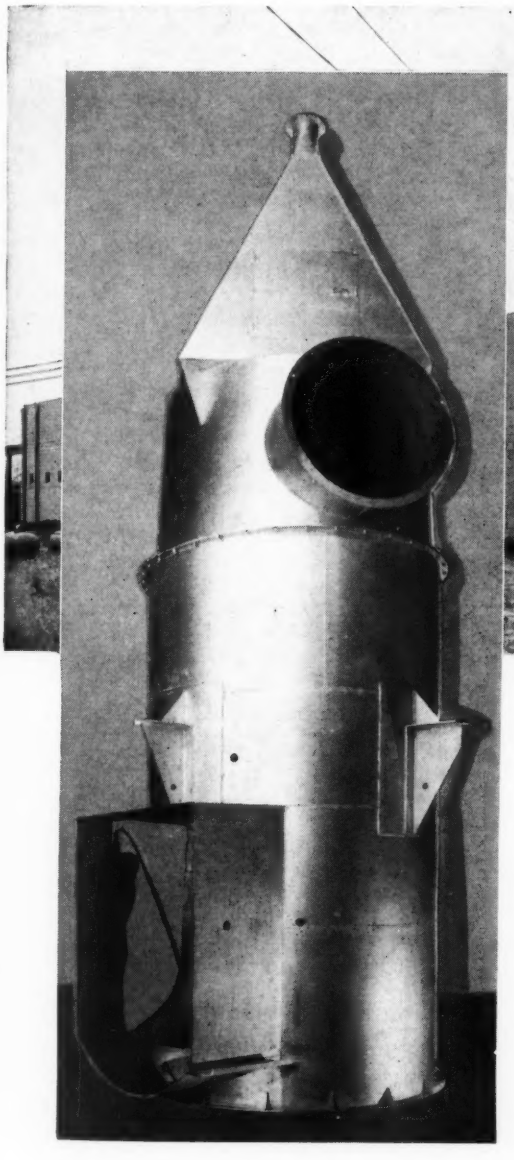

Photo at left shows one of two cooling chambers, integral components of vortex type dust collectors. Special design by Grindle Corporation eliminates dust, fumes, general smoke nuisance from expanded cupolas and stacks of major Detroit automobile manufacturer.

After-cooler pictured above is typical of heavy *precision* weldments manufactured by Foster. New building has heavy duty over head crane facilities; houses new equipment for shearing, burning, bending, braking, forming, annealing, sand-blasting.

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# MEN IN ENGINEERING

Louis Rossetti, chief architect of the Detroit firm, Giffels & Vallet, Inc., L. Rossetti, Associated Engineers and Architects was elevated to Fellowship in the American Institute of Architects, for "Achievement in Design."

New president of the Metropolitan Section of the American Society of Civil Engineers is Richard Hazen, a partner in the firm of Hazen & Sawyer, of Dobbs Ferry, New York. Other officers are: vice president, Roger H. Gilman, deputy director of Port Development, The Port of New York Authority; directors, Malcolm Pirnie, Jr., Gordon Wallace, and Eugene D. Jones; treasurer, William J. Shea; and secretary Arthur J. Fox.

The Cornell Society of Engineers has elected the following new officers: president, William M. Leonard, Consolidated Edison Co.; executive vice president, Walter L. Hardy, Foster D. Snell, Inc.; secretary-treasurer, Daniel M. Lazar, Cayuga Construction Co.; recording secretary, Richard W. Eustis, Esso Standard Oil Co.

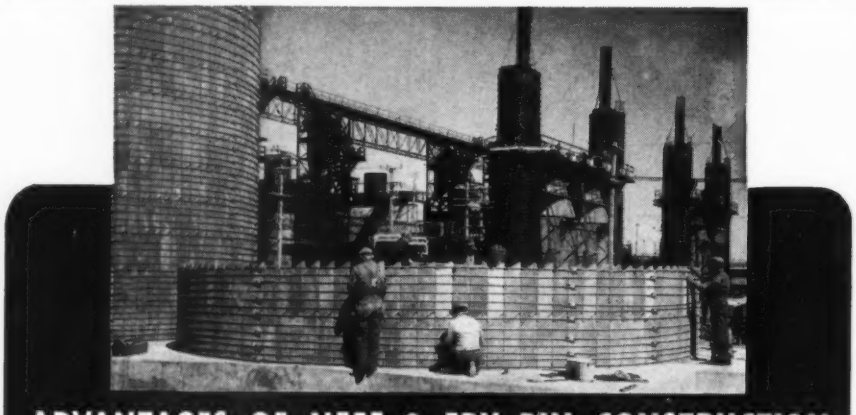
Dr. Charles N. Kimball, president of Midwest Research Institute, has received an honorary Doctor of Engineering degree from Northeastern University for his pioneering research in television and his work in development of Midwest.

Enoch R. Needles, senior partner of Howard, Needles, Tammen & Bergendoff, has been named by the Board of Direction of the American Society of Civil Engineers as its nominee for president.

Ford J. Twaits, partner in the contracting and engineering firm of the same name, has been elected to the Board of Trustees of the Air Pollution Foundation.

John Graham and Company, of Seattle, Wash., specializing in architectural and engineering services in the commercial, industrial, and institutional fields, is opening New York City offices at 15 West 44th Street. Jack L. Follett will head up the new office with George Baumgarten as assistant. Roland Wilohen will direct technical production for the office.

At the first annual meeting of the American Nuclear Society, Dr. W. H. Zinn was elected president. He is a director of the AEC's Argonne National Laboratory. Other officers are: Philip Sporn, American Gas & Electric Co., vice president; Dr. Karl

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The photo shows a Neff & Fry Bin being erected alongside another which is completed.

A course of tongued and grooved staves has just been laid up and the steel hoops are being adjusted. Observe that the stave ends are diagonal. All stave ends in a horizontal joint are supported by a hoop, not possible if the staves were rectangular.

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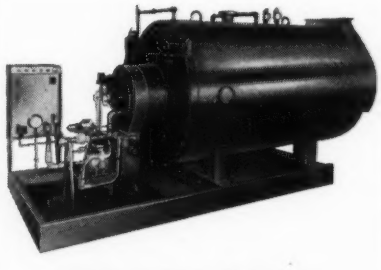

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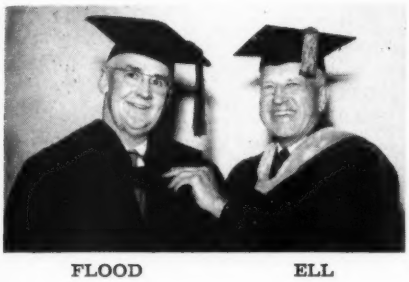
Cohen, Walter Kidde Nuclear Laboratories, Inc., treasurer; and Dr. J. G. Beckerly, Schlumberger Well Surveying Corp., editor.

John Rivoire has been appointed manager of the newly formed Industrial Economics Division of Midwest Research Institute. The new division will allow Midwest to expand its activities in the fields of market research, area development, input-output studies, and in fields where industry is in need of additional data and market information.



FLOOD ELL

Frank L. Flood, partner in the firm of Metcalf & Eddy, Boston, is shown receiving a hood signifying an honorary Doctor of Engineering degree from Northeastern University's president Carl S. Ell.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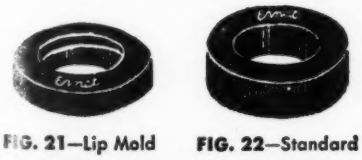

FIG. 21—Lip Mold FIG. 22—Standard

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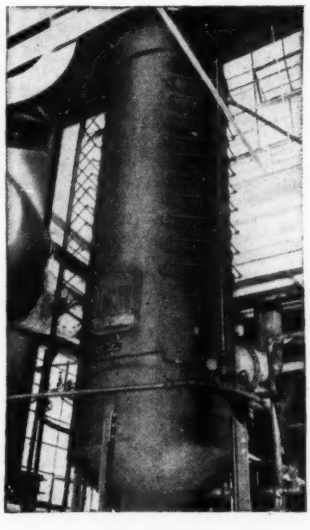

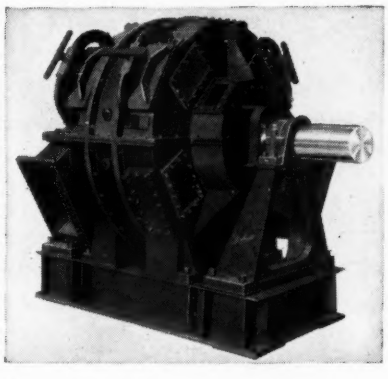

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# consulting engineers' calendar

| Date | Sponsor | Event | Location |
|---|---|---|---|
| Aug. 15-19 | American Institute of Electrical Engineers | Pacific General Meeting | Butte, Mont. |
| Aug. 22-23 | National Industrial Conference Board and Stanford Research Institute | Conference | San Francisco, Calif. |
| Sept. 7 | American Institute of Consulting Engineers | Monthly Meeting | Engineers' Club New York, N.Y. |
| Sept. 12-16 | American Society of Mechanical Engineers and Instrument Society of America | Exhibit and Joint Conference | Shrine Auditorium Los Angeles, Calif. |
| Sept. 12-16 | Illuminating Engineering Society | National Technical Conference | Statler Hotel Cleveland, Ohio |
| Sept. 20-22 | Society of Industrial Packaging and Handling Engineers | Packaging and Handling Exposition | Kingsbridge Armory New York, N. Y. |
| Sept. 25-28 | American Institute of Chemical Engineers | Conference | Lake Placid Club Lake Placid, N.Y. |
| Sept. 25-28 | American Society of Mechanical Engineers | Petroleum-Mechanical Conference | Roosevelt Hotel New Orleans, La. |
| Sept. 26-30 | Atomic Industrial Forum | Fall Meeting and Trade Fair | Sheraton-Park Hotel Washington, D.C. |
| Oct. 3-5 | National Electronics Conference, Inc. | Conference | Hotel Sherman Chicago, Ill. |
| Oct. 3-7 | American Institute of Electrical Engineers | Fall General Meeting | Morrison Hotel Chicago, Ill. |
| Oct. 5 | American Institute of Consulting Engineers | Monthly Meeting | Engineers' Club New York, N.Y. |
| Oct. 12-15 | American Chemical Society | 8th National Chemical Exposition | Coliseum Chicago, Ill. |
| Oct. 13 | American Institute of Chemical Engineers | Symposia | Hotel Statler New York, N.Y. |
| Oct. 19-20 | American Society of Mechanical Engineers and American Institute of Mining and Metallurgical Engineers | Joint Fuels Conference | Neil House Columbus, Ohio |
| Oct. 28-29 | Associations of Consulting Engineers | National Meeting of Consulting Engineers Assocs. | St. Louis, Mo. |

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Top engineers of The Kuljian Corporation, Consulting Engineers, Philadelphia. Starting at left, Arthur H. Kuljian, VP Engineering; Frank X. Bonnes, Ch. Electrical Engineer; Harry A. Kuljian, President and Chairman of the Board; William J. Fadden, Jr., Ch. Mechanical Engineer; James L. Cherry, Exec. VP; Hilton A. Levonian, VP, Consulting Engineering; Hrand H. Levonian, VP, Construction.

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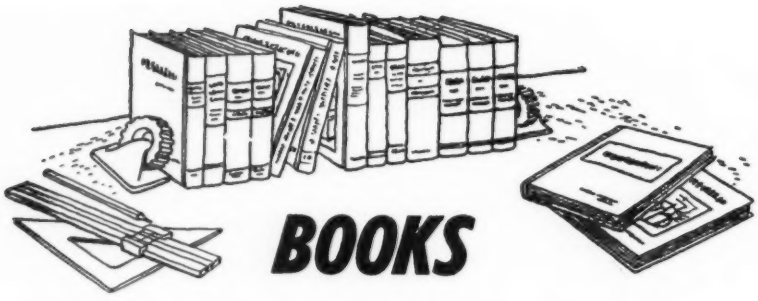

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STRENGTH AND RESISTANCE OF METALS, by John M. Lessells; John Wiley and Sons, Inc.; 450 pp; $10.00.

*Reviewed by W. Rostoker*
*Supervisor, Physical Metallurgy Research*
*Armour Research Foundation*

This book seems to be intended as a running mate for the standard texts on "Strength of Materials." While the latter treats the analytical problems of correlating loading configurations and geometry, Lessells' book handles the general subject of the phenomenological behavior of metals (overwhelmingly steels) under various conditions of test. As such it is primarily descriptive.

Chapter I is a rather elementary discussion of the tensile test. The topic of true stress-strain relationships is dealt with summarily with no mention, for instance, of strain hardening exponents. Chapter 2, entitled peculiarly "The Elastic Stage Modification," treats of what the metallurgist calls the strain aging phenomenon in low and medium carbon steels. The topics of creep and stress rupture, hardness, and impact are discussed in the succeeding three chapters. The subject of fatigue is discussed in lengthy fashion in Chapters 6 and 7. This is obviously a subject with which the author has had considerable experience. The topic is continued as Chapter 8 under the guise of the "Fracture of Metals." Three more chapters round off the book with discussions of strain hysteresis, mechanical wear, and theories of strength.

A text of this nature should sketch pertinent topics in generalized terms, providing ample selected references for the reader to pursue any subject more deeply. The author constructed the book in this fashion although he has a penchant for very old and original references which are certainly available only in the most complete libraries. It would have been better to sacrifice chronological correctness for availability to the large majority of readers.

The book will have a use as a


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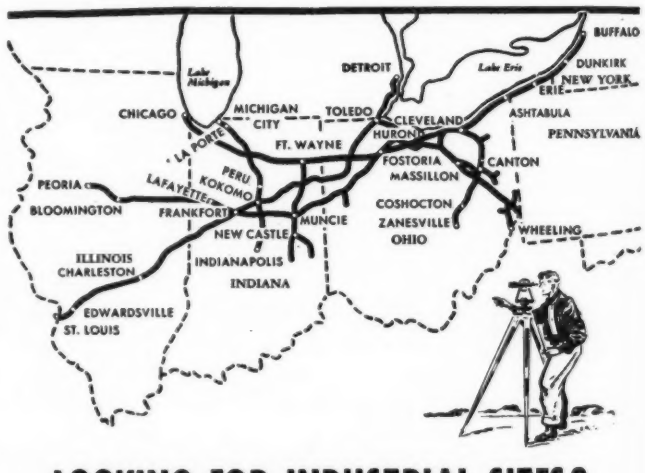


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senior text for both mechanical and metallurgical engineers. The professional engineer will find it a useful addition to his library for quick refresher reviews. For more comprehensive engineering data, it should be used in conjunction with books such as the ASM Metals Handbook and S. L. Hoyt's *Metal Data*.

•

TRANSIENT LINEAR ANALYSIS, Vol. I, Lumped-Parameter Two-Terminal Networks, by Ernst Weber; John Wiley & Sons; 348 pp; $7.50.

*Reviewed by A. E. Fitzgerald*
*Jackson & Moreland, Engineers*

During the past 10 to 15 years, there has been an increasing number of books devoted to the more advanced mathematical aspects of transient analysis. The principal impetus behind the production of these books has been the need for comprehensive analytical techniques in the rapidly developing fields of control and communications engineering. The primary contribution of these books has been the important one of translating reasonably abstruse mathematical concepts into valuable engineering tools. The present book is in this general category.

The first of a two-volume series, this book was prepared as a text for advanced-senior and graduate courses in electrical engineering. It uses electric-circuit analysis as the specific application around which to develop the analytic details. The first chapter briefly reviews the circuit concept and the elements of network theory. The second chapter then reviews the classical-differential-equation approach to electric transients. The third chapter treats electromechanical and thermal analogues in order to make evident the wider applicability of circuit concepts. Succeeding chapters take up the Heaviside operational calculus, the Laplace transform method, and the Fourier integral and transform approach.

The book is well and carefully written. Because of the nature of the subject, thorough study is required. An advantage of this text is that the reader is introduced to all the currently used methods of linear transient analysis. The author's critical comments and evaluations of the various methods are a definite asset in furnishing over-all perspective. Bibliographical references are given in footnotes and in an appendix.


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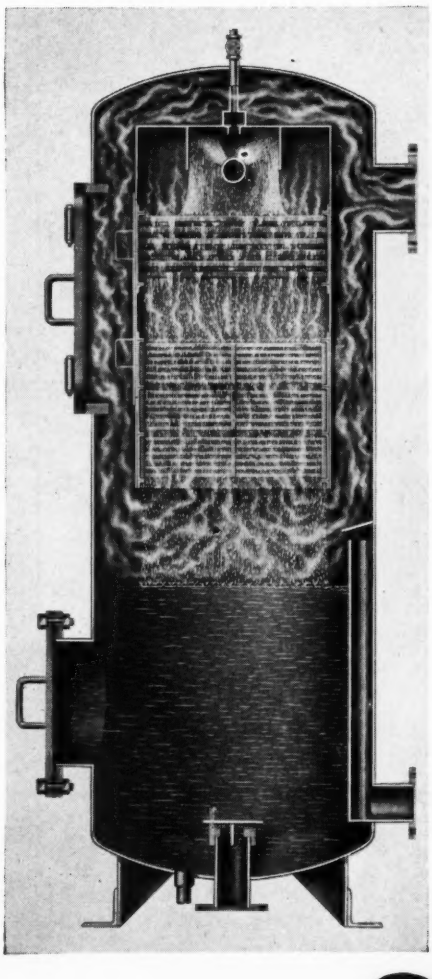

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